ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

MAY 22, 1950 • OUR 76th YEAR

Blueprinting The Future

THE POLITICAL SETTING—Big government, big labor

THE ECONOMIC OUTLOOK—Growth for 1950-1965

LOAD GROWTH—Triples in 15 years

GOVERNMENT & OTHER POWER SYSTEMS—How fast will they grow?

NATIONAL POWER SUPPLY—For peace or for war?

TRENDS IN GENERATION—The shape of things to come

TRANSMISSION—Higher voltage for greater loads

SUBTRANSMISSION—More capacity at less cost

DISTRIBUTION—Better service, appearance and economy

RATE FORMS—Simple and uniform at cost of service

COMMUNITY RELATIONS—The future depends on them

ORGANIZATIONAL SYSTEMS—More and better trained personnel

TRIPLE PROTECTION

TEXACO REGAL OILS (R&O) protect turbines against Rust, Sludge and Foam

No rust, no sludge, no foam—you can count on that when you lubricate turbines with *Texaco Regal Oils (R & O)*. Oil systems stay clean; bearings get the full protection of a constant, uninterrupted flow of oil; governor action remains instantly responsive.

The outstanding performance of *Texaco Regal Oils (R & O)* stems from fine base stocks. Special refining processes assure the quality needed for efficient turbine lubrication. Then they are fortified with additives to inhibit rust and oxidation and are specially processed to prevent foaming.

Texaco Regal Oils (R & O) give extra protection throughout an extra long service life. They meet the stringent requirements of all leading turbine builders.

Let a Texaco Lubrication Engineer help you raise efficiency and reduce costs in the operation of both turbines and auxiliaries. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.

OF PERSONAL INTEREST

Everything about the Philip Sporn plant is aimed to set new standards of economy in operation and capital investment. Location, for instance; it is on the Ohio River at the boundary of the two largest operating groups in the American Gas and Electric Co.: The Ohio Power Co. and Appalachian Electric Power Co.

Since the two companies own the plant jointly, it is twice as big as either company's share of its production facilities. This makes possible saving for each company in coal unloading and ash handling, coal storage, machine shop facilities, etc. Each benefits from lower fuel and supply costs and lower costs of supervision, operation, maintenance.

At its ultimate capacity of 900,000 kw, the Sporn plant will burn close to 200,000 tons of coal a month. You could not project plans for a plant of this size, let alone build it, without first having reasonable assurance of continuous economical coal supply.

The Sporn Station is located approximately in the center of a coal reserve of 22,348 acres, holding around 90,000,000 tons of recoverable coal, subject to no freight costs.

Those are just a couple of details illustrating the breadth of planning that went into this station.

In achieving its standard of operation economy, the new Philip Sporn station utilizes all the technical lessons learned from the Missouri Avenue, Tidd, Twin Branch and the company's other generating stations. Thus, the Sporn Station is the peak achievement in the process of learning through doing.

And because it marks an important milestone in the development of thermodynamics, the Sporn Plant's principal features of design, architecture, control and operation are carefully described by American Gas and Electric men in **Electrical World** for June 5.

This is another step in **Electrical World's** unique editorial service to designers and operators of utility generating plants. Like the other two "The 6th Steam Station Cost Survey," and the "Characteristics of 81 Post War Power Plants") it is concerned with engineering reasoning rather than a mere listing of construction details.

Cordially,
THE EDITORS

ELECTRICAL WORLD

Published for 76 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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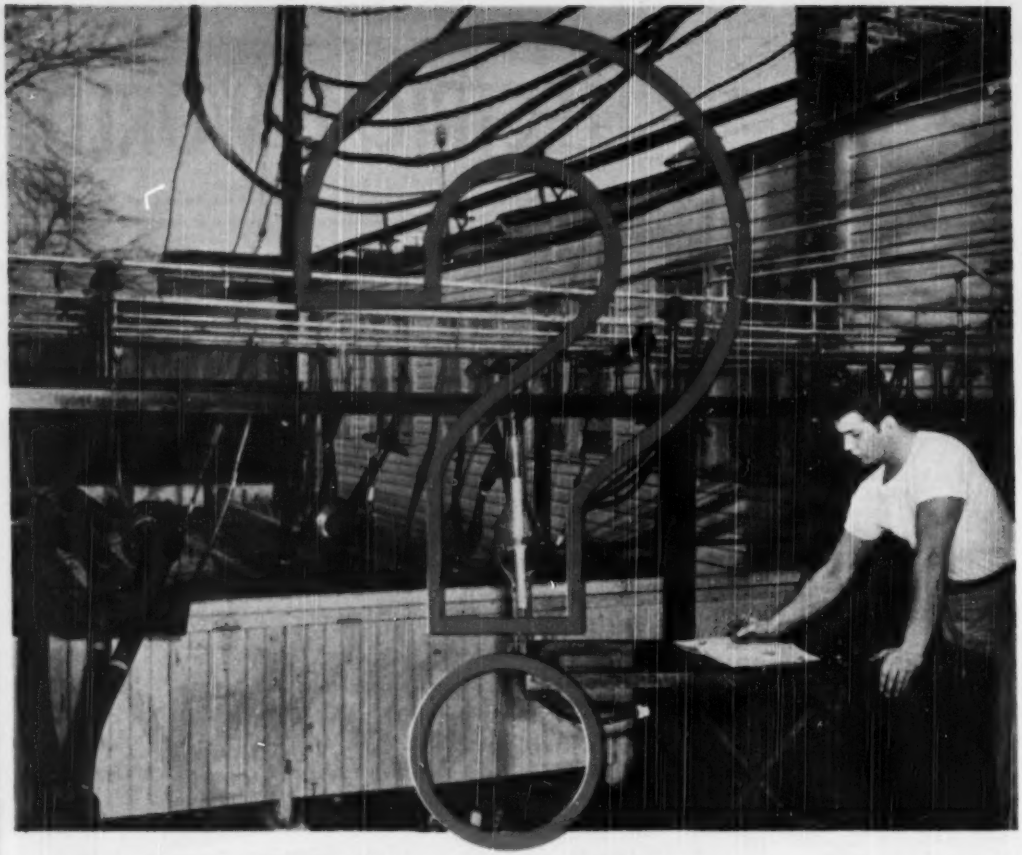


WHERE CABLE QUESTIONS OF THE FUTURE ARE BEING ANSWERED NOW

THIS is the Okonite proving ground. Within its bounds are concentrated the toughest cable tests that experience can devise. Here, lengths of every kind of cable—overhead or underground, clad in every type of insulation and protective covering—go in to stay for years, under continuous high voltage and alternating load cycles.

Underground cables are buried in "graves" filled with soils of all types, saturated with chemical wastes, sewage, salt brine . . . attacked by every enemy that may be encountered in actual installations. Overhead cables are exposed to a wide range of year-round weather conditions. Periodic examination of the cables includes disinterment, careful examination of coverings, complete electrical and physical measurements to determine rates of deterioration. Only the fittest can eventually survive.

But this rigorous proving ground is open only to the "elect"—cable specimens that have previously survived months and years of hundreds of searching laboratory tests and experiments. Nor are all these results considered conclusive. No matter how successful in the laboratory and on the proving ground, every new Okonite wire or cable must pass the test of experience in the field before the final verdict is returned.

Now in its thirteenth year of operation, the Okonite proving ground is but one phase of the sternest testing techniques employed in the cable manufacturing industry today. It helps to explain why, tomorrow as in the past 72 years, you can continue to depend on Okonite for the right answers to your toughest cable problems. The Okonite Company, Passaic, N. J.

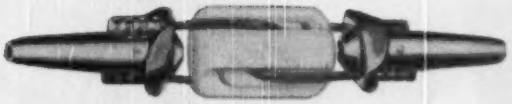
THE BEST CABLE IS YOUR BEST POLICY

OKONITE SINCE 1878 *insulated wires and cables*

9341

Electroline Automatic Insulating Line Splice SECTIONALIZERS

2200 AND 2300 SERIES



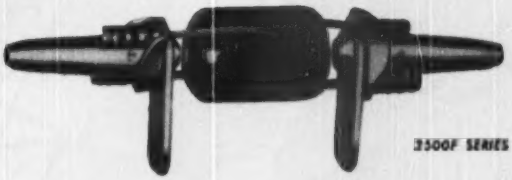
2500 SERIES

These Automatic Insulating Line Splice Sectionalizers offer a large number of line applications —at the lowest possible cost. You'll find these Electroline Sectionalizers ideal for

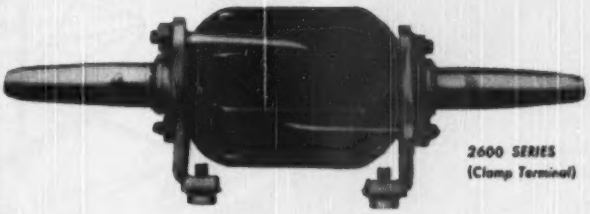
- **REGULATING SECONDARY VOLTAGES**
  Facilitates secondary voltage regulation when used to bank transformer secondaries.
- **FUSING TRANSFORMERS**
  Gives transformers real protection when used to fuse transformer leads.
- **SECTIONALIZING NETWORKS**
  Suitable for sectionalizing networks to isolate the area in trouble.
- **SERIES STREET LIGHTING**
  Simplifies cutting-in series street lamps—merely cut the line and insert conductor ends into sectionalizer.

The mechanical strength of these assemblies exceeds in all cases the rated breaking strength of the conductor size for which they are adapted.

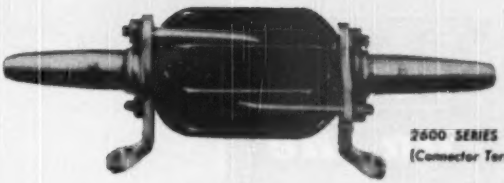
The wet process porcelain insulators used in the 2500 and 2600 series sectionalizers can, if desired, be furnished with a white glaze to reflect the beam of the lineman's searchlight when locating trouble at night.



3500F SERIES



2600 SERIES
(Clamp Terminal)



2600 SERIES
(Connector Terminal)

Send for New Bulletin

Electroline Company

4121 South La Salle Street • Chicago 9, Illinois • IN CANADA—POWERLITE DEVICES, LTD., TORONTO

POWER *on the march*

An impressive percentage of the new capacity being developed by the power industry utilizes the skills of Bechtel engineers and construction forces. Fifty years of organized experience is ready to build power facilities wherever needed.

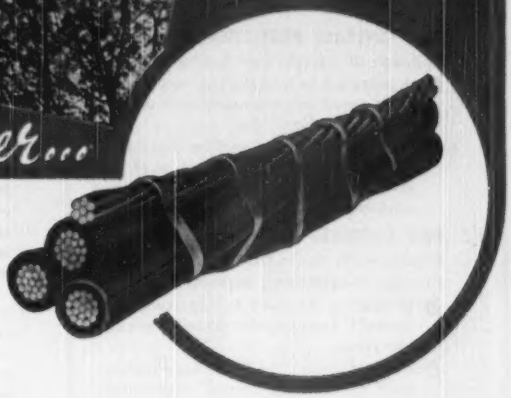
BECHTEL CORPORATION

Los Angeles • **SAN FRANCISCO** • *New York*
Tulsa

"BUILDERS FOR INDUSTRY"

DESIGN • ENGINEERING • CONSTRUCTION

DEPENDABLE ALWAYS!!



Whichever the season, there's seldom any worry about overhead power lines, or customer relations either, when Simplex - ANHYDREX Self - Supporting Aerial Cables are on the job. Anhydrex insulated and neoprene jacketed, they assure trouble-free service year in and year out in any location, and their modern construction does away with the need for excessive tree-trimming.

Anhydrex has excellent electrical properties and is the most stable of all rubber insulations when exposed to water and moisture. The tough neoprene jacket withstands abrasion caused by swaying limbs and chafing against poles and it provides effective protection against fungus, heat, sunlight and weathering.

ANHYDREX Self-Supporting Aerial Cables require little or no tree trimming for installation. The circuit is entirely insulated, and the copper bindings that secure the conductors to the messenger provide a grounded path on the outside. During storms the strong supporting messenger retards line breaks due to falling limbs and ice-loading. Even when poles fall, the well-protected cables will usually continue to operate efficiently.

ANHYDREX Self-Supporting Aerial Cables are delivered ready for installation. They can be clamped to poles already standing. Crossarms and insulators are unnecessary. Few workmen and comparatively little time are needed for the job. But these are but a few of the advantages they provide. For the complete story, simply fill in and return the coupon below.

SIMPLEX WIRES & CABLES

SIMPLEX WIRE & CABLE CO.
79 Sidney Street
CAMBRIDGE 39, MASS.

SIMPLEX WIRE & CABLE CO.
79 SIDNEY ST., CAMBRIDGE 39, MASS.
GENTLEMEN: PLEASE SEND A COPY OF CATALOG 1006 TO:

NAME _____ TITLE _____
COMPANY _____
STREET _____
CITY _____ STATE _____

A New Fuse FOR THE NEW FUSING CONCEPT—

ANNOUNCING AT THIS TIME additional voltage ratings, a choice of time-current characteristics, and other important new features, we remind you that the SMD-2 is a modern fuse so far advanced in design that the present concepts of high voltage fuse application must be expanded if full advantage is to be taken of the economy inherent in fuse protection of transmission and sub-transmission systems.

* **FULL COVERAGE PROTECTION IS:** the new concept of transformer fusing in which:

1. A primary fuse is applied for both primary short circuit and secondary back-up short circuit protection.
2. A fuse is expected to perform dependably regardless of type of system; type of fault current; type of application; or system and atmospheric conditions.

* **FULL COVERAGE PROTECTION PROVIDES**— along with the above protection— savings in operating expense by:

1. Eliminating the need for replacement of "suspect" fuses on other phases when one fuse blows.
2. Eliminating the need for periodic replacement of fuses to prevent "sneak-outs" caused by vibration- or age-weakened fusible elements.

* **FULL COVERAGE PROTECTION REQUIRES:**

A. dependable high and low fault-current interrupting ability;
B. protection against dielectric breakdown or external flashover from severe recovery voltage;
C. a fine degree of accuracy in time-current characteristics;
D. a "non-damageable" fusible element which cannot be injured by surge currents, vibration, or aging;
E. a choice of time-current characteristics to provide flexibility in coordinating with other primary, and with the secondary, protective devices.

The SMD-2 offers short circuit interrupting capacity many have thought could only be obtained with a circuit breaker; yet it is more reliable than a breaker. And the SMD-2 costs so much less that economic necessity need no longer compel a choice between the expense of a breaker or the often used expedients of solid tie, grounding switches, or remote-trip-relay protection, when tapping transmission and sub-transmission lines.

Permanent accuracy of the SMD-2 time-current characteristics permit sufficiently close fusing of the transformer bank to get back-up protection in case of secondary bus faults or failure of secondary protective devices—and this protection is accomplished without incurring outages caused by unwanted fuse operations.

The importance of fusing for secondary protection has been demonstrated by field experience which has shown that more than half of the operations of fuses thus applied were caused by secondary faults that most certainly would have damaged or destroyed the transformers. With the SMD-2 this valuable secondary protection is obtained in addition to a full measure of primary protection.

SMD-2 HIGHLIGHTS

Voltage Range: 34,500 to 138,000.

Interrupting Ratings: to 1,000,000 KVA.

In fuses of low ampere ratings, low fault currents are positively interrupted by an auxiliary gas-blast arc extinguisher.

Drop-out release is protected against opening from vibration or shock by a floating, self-aligning, latch mechanism.

Drop-out, when intended, is assured by a powerfully spring driven pry out lever, and a "wiping-in, rolling-out" contact design.

Initial and permanent accuracy of time-current characteristics are provided by non-damageable fusible elements.

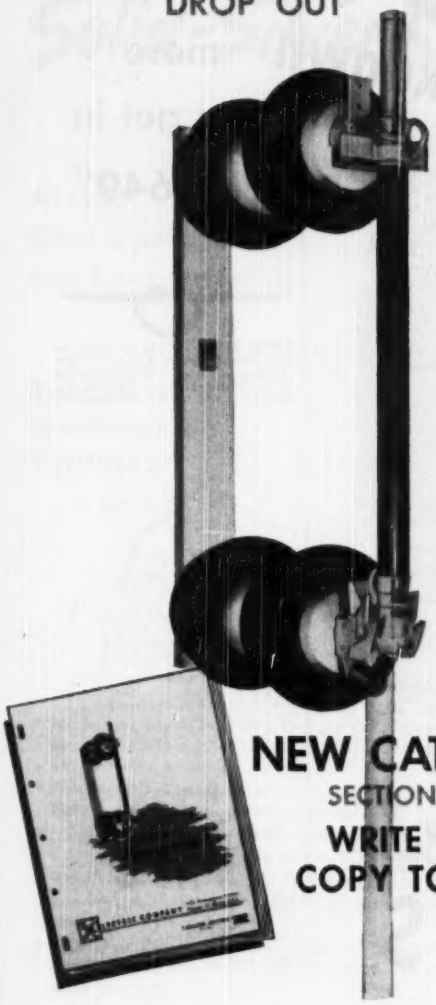
For a complete account of this new protective device you should have the new Catalog Section 202, now ready. Write for a copy today!

S&C ELECTRIC COMPANY

Formerly SCHWEITZER & CONRAD, INC.

*Full Coverage**

SMD-2 POWER FUSE
DROP OUT

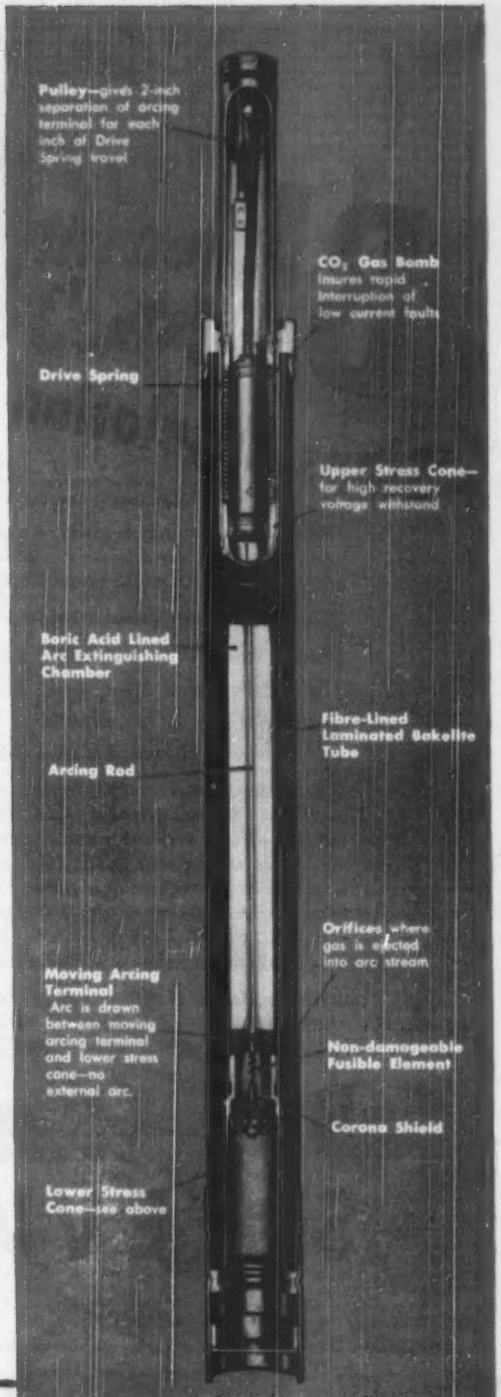


NEW CATALOG
SECTION 262

WRITE FOR COPY TODAY!

4421 Ravenswood Avenue
Chicago 40, Illinois, U. S. A.

In Canada, Powerlite Devices, Limited, Toronto


Pulley—gives 2-inch separation of arcing terminal for each inch of Drive Spring travel
CO_2 Gas Bomb Insures rapid interruption of low current faults
Drive Spring
Upper Stress Cone—for high recovery voltage withstand
Baric Acid Lined Arc Extinguishing Chamber
Fibre-Lined Laminated Bakelite Tube
Arcing Rod
Orifices where gas is ejected into arc stream
Moving Arcing Terminal Arc is drawn between moving arcing terminal and lower stress cone—no external arc.
Non-damageable Fusible Element
Corona Shield
Lower Stress Cone—see above

CUTAWAY VIEW OF FUSE UNIT

BH "649"

Stops Insulation Breakdown

One of the largest manufacturers of electrical equipment required an insulation that was definitely non-corrosive and non-fogging, in addition to being toughened against abrasion.

They found what they wanted in BH "649":

(1) Rated dielectric strength retained even after roughest handling

(2) No corrosion of silver, brass, aluminum, copper or nickel-plated parts

(3) No evidence of fogging on glass under test conditions

If you require a tough insulation with superior dielectric properties, you will be interested in tests made on BH "649" by leading manufacturers of television and radio, transformers, meters, electronic instruments, aviation instruments. They have found that BH "649" is unaffected by severe bending in assembly or product use. They have learned that BH "649" stays supple after baking 12 hours at 300°F. BH "649" is made in Grades A-1, B-1, C-1 and C-2—in all sizes from No. 24 to 3/8" inclusive. Write for production samples.

BENTLEY, HARRIS MANUFACTURING CO., CONSHOHOCKEN, PA.

BH *Fiberglas** SLEEVINGS

See how much more you get in BH "649"

KNOT IT . . . Take a length of BH "649". Knot it. Pull it as tight as you can. Twist it. Then loosen the knot. There is no cracking. No change in the dielectric strength.

RUB IT . . . Take a length of BH "649". Rub the sample up and down briskly against the edge of a desk or chair. See how difficult it is to damage the coating.

HOLD A MATCH UNDER IT . . . Take a length of BH "649". Hold a lighted match under it. BH "649" will not support combustion.

COUPON

Bentley, Harris Mfg. Co., Dept W 40, Conshohocken, Pa.

I am interested in BH "649" Fiberglas Tubing and Sleeving. Send samples for production testing of Grade_____ in sizes as follows_____ (size or I.D.) for_____ (product) operating at temperatures of_____°F. at_____volts.

NAME _____

ADDRESS _____

Send samples, pamphlets and prices on other BH Products as follows:

☐ BH non-fraying Fiberglas Sleeving

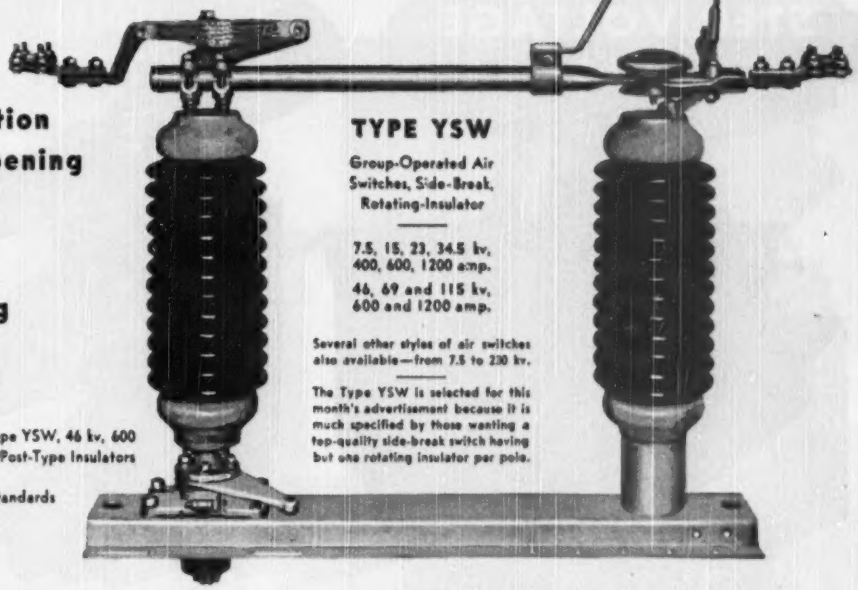
☐ Cotton or Rayon-base Sleeving and Tubing

PACIFIC ELECTRIC
Type YSW
SWITCHES

Carry the Load through Solid-Silver Rolling Contacts

Assure Cool Operation and Easy Opening

Special Ice-Breaking Features



Showing Type YSW, 46 kv, 600 amps, with Post-Type Insulators

NEMA Standards

TYPE YSW

Group-Operated Air Switches, Side-Break, Rotating-Insulator

7.5, 15, 23, 34.5 kv, 400, 600, 1200 amp.

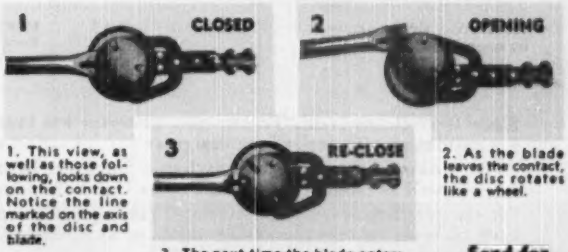
46, 69 and 115 kv, 600 and 1200 amp.

Several other styles of air switches also available—from 7.5 to 230 kv.

The Type YSW is selected for this month's advertisement because it is much specified by those wanting a top-quality side-break switch having but one rotating insulator per pole.

- Solid-silver inserts in rolling discs permit high-pressure contact (adjustable up to 80 lb), yet assure easy opening or closing.
- Floating self-aligning roller-contact design, as illustrated, assures easy operation, always.
- Ice is broken progressively because discs swivel sideways before starting to rotate.
- Rotating insulators have widely spaced ball or roller bearings with weather shields. All parts non-ferrous above insulator caps.
- Operating linkage for 3- or 6-pole switch has stainless-steel pins and mostly anti-friction sleeve or roller bearings.

How the Exclusive Rolling Contacts Reduce Friction, "Run" Cooler, and Assure Easier Operation



1. This view, as well as those following, looks down on the contact. Notice the line marked on the axis of the disc and blade.

2. As the blade leaves the contact, the disc rotates like a wheel.

3. The next time the blade enters contact, an entirely new contact position is presented to the blade.

Get All Facts . . .

Send for Catalog 130

Calif

PACIFIC ELECTRIC MFG. CORPORATION

5815 THIRD STREET · SAN FRANCISCO 24 CALIFORNIA · P. O. BOX 619 · GARY, INDIANA

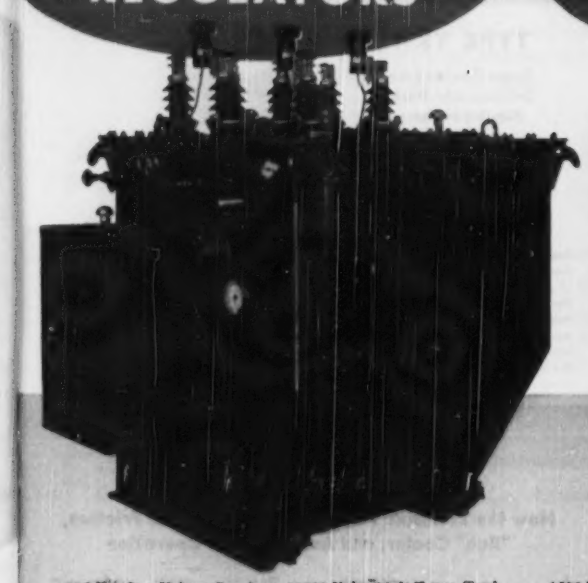
Other Representatives in Principal Cities

PENNSYLVANIA TRANSFORMER

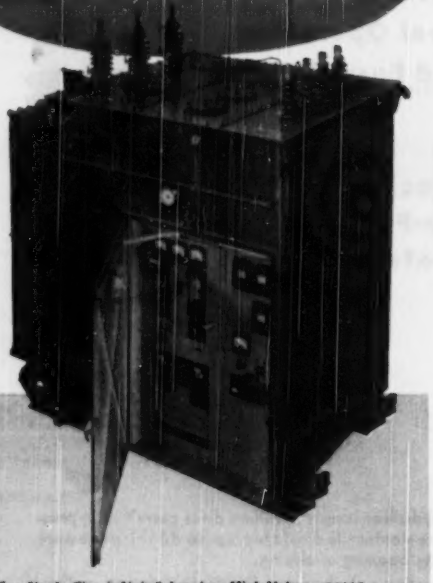
LOAD RATIO

for STEP VOLTAGE REGULATORS

for UNIT SUBSTATIONS



196 Kva Step Voltage Regulator. 12000 Volts. 32-⅝% taps. Total tap range plus or minus 10%.



1500 Kva Single Circuit Unit Substation. High Voltage:-22000 Volts. Low Voltage:-4160 Volts. 32-⅝% taps on Low Voltage winding.

Since 1937 Pennsylvania Transformer Company has been building Load Ratio Control Equipment for customers who desired the design and construction advantages of Pennsylvania Transformers.

About 5 years ago, Pennsylvania Engineers began developing Step Voltage Regulators as well as Single Circuit and Duplex Unit Substations.

For the past few years, Pennsylvania Transformer Company has been taking orders for, and has been building in ever increasing numbers, Load Ratio Control Transformers, Step Voltage Regulators and Unit Substations.

Recently Pennsylvania completed a new, modern Machine Shop designed specifically for manufacturing Load Ratio Control Equipment.

Now Pennsylvania is completely equipped and tooled to build Load Ratio Control Units on a regular production basis.

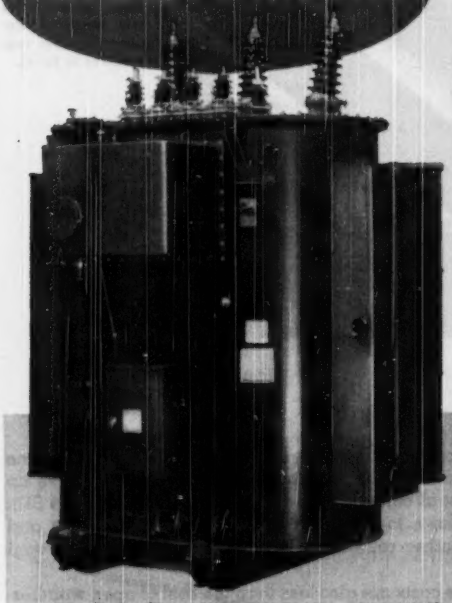
COMPANY

Announces

CONTROL

for

TRANSFORMERS



2500 Kva, 3 Phase, 66000-2500/4330Y x 7500/12990Y Volts. Low Voltage winding equipped with 16-15/16% taps for automatic tap changing under load.

Finished units ready for shipment. Reading right to left: 1-239 Kva Step Voltage Regulator; 1-1500 Kva Single Circuit Unit Substation; 4-2500 Kva Load Ratio Control Transformers for multi Unit Substations.

Pennsylvania's modern Machine Shop completely equipped with the latest machine tools for manufacturing Load Ratio Control equipment.

This is Pennsylvania's formal announcement to America's Utilities and Industrials that Pennsylvania Transformer Company is now regularly quoting on all types of Load Ratio Control equipment and Step Voltage Regulators.

Further information can be obtained by contacting a Pennsylvania Representative or by writing directly to Pennsylvania Transformer Company, P. O. Box 330, Canonsburg, Pa.

Pennsylvania

TRANSFORMER COMPANY

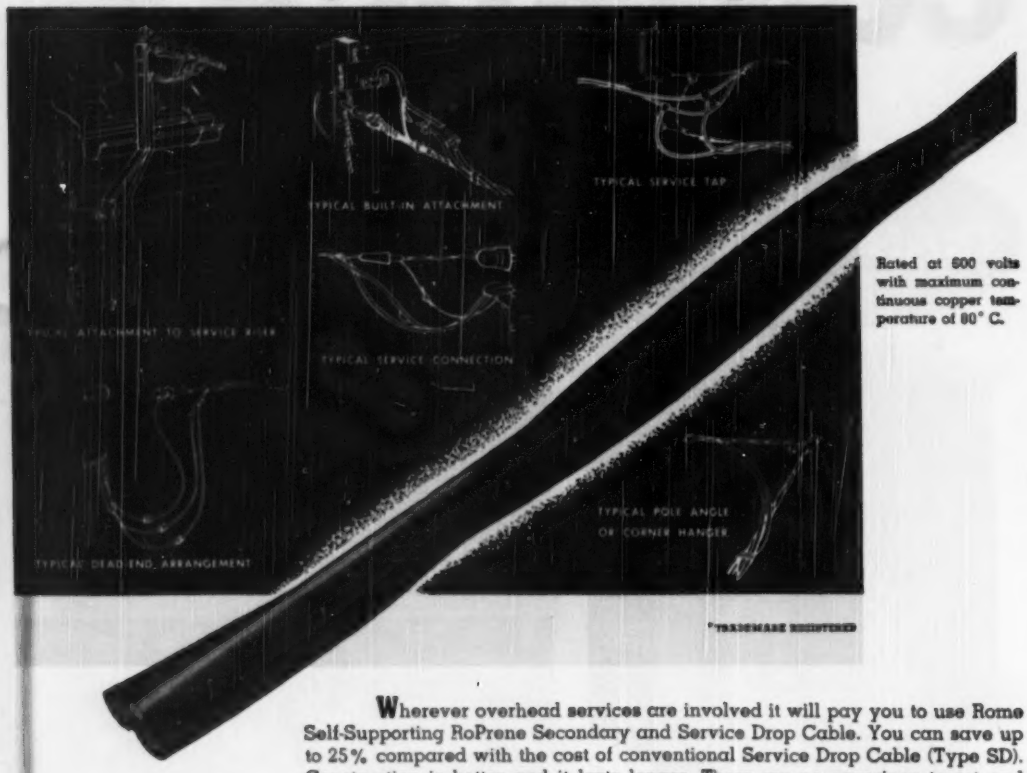
CANONSBURG • PENNA.

Greater Pittsburgh District

Pennsylvania TRANSFORMERS

SAVE UP TO 25%...

with Rome Self-Supporting RoPrene Secondary and Service Drop Cable



Rated at 600 volts with maximum continuous copper temperature of 80° C.

*TRADEMARK REGISTERED

Wherever overhead services are involved it will pay you to use Rome Self-Supporting RoPrene Secondary and Service Drop Cable. You can save up to 25% compared with the cost of conventional Service Drop Cable (Type SD). Construction is better and it lasts longer. There are no coverings to rot and festoon. It has remarkable weather resistance. It possesses excellent physical and electrical characteristics.

Installation and maintenance costs are also less than the cost of open weatherproof wire. Less labor and cheaper hardware can be used. When used as secondaries, Rome Self-Supporting RoPrene Cable is more compact, eliminates unsightly multiple wire construction, jointly occupied poles and long spans. On larger sizes, there is also a substantial saving in copper losses due to the lower reactance of a self-supporting cable compared with open wires.

NEW DATA AVAILABLE!—BULLETIN RS-4, just published contains specification and test details, as well as sag and tension data on Rome Self-Supporting RoPrene Cable. It's yours for the asking. Sign and mail the coupon below or write.

IT COSTS LESS TO BUY THE BEST...BUY ROME CABLE

ROME CABLE CORPORATION, Dept. EW-5, Rome, N. Y.
Please send me Bulletin RS-4

Name ..... Title .....

Company .....

Street .....

City ..... Zone ..... State .....

ROME CABLE
Corporation
ROME - NEW YORK
From Bar to Finished Wire

ROME CABLE ROME, N.Y.

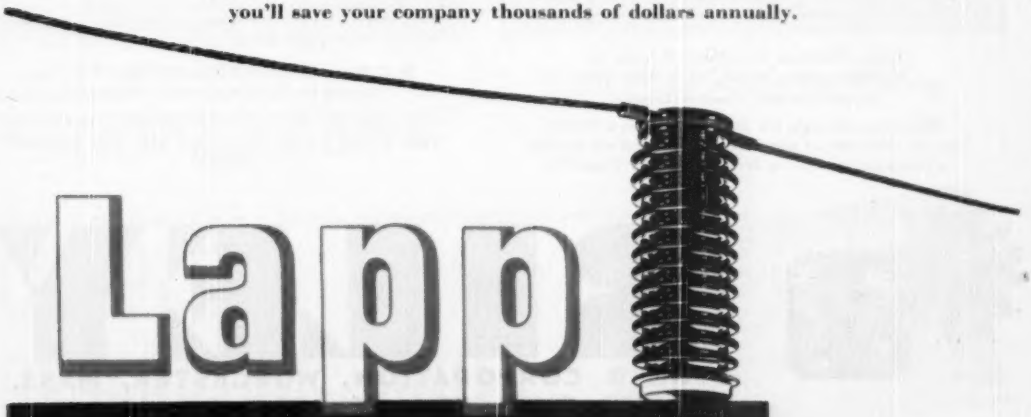
Remember this Ad

Next time you get a bad lightning storm...

• Maybe you think your company has "no trouble" with transmission insulators... How many pin-type insulators do you suppose had to be replaced as the result of your last bad lightning storm? Just "normal" replacement, you may think; "Every piece of equipment calls for a certain amount of maintenance, and insulator costs are low."

We strongly urge you to take a critical and detailed look at those "normal" transmission insulator maintenance costs. We predict that you'll find it a whale of a lot bigger expense item than you suspect. What's our reason for wanting you to know just what that cost item is?

...why, we've got an insulator with a proved record of ability to cut that expense to a tiny fraction of what it now is. The Lapp Line Post. We think that if you'll make a fair comparison of maintenance costs, you'll standardize on Lapp Line Posts for all transmission duty up through 69Kv. And you'll save your company thousands of dollars annually.

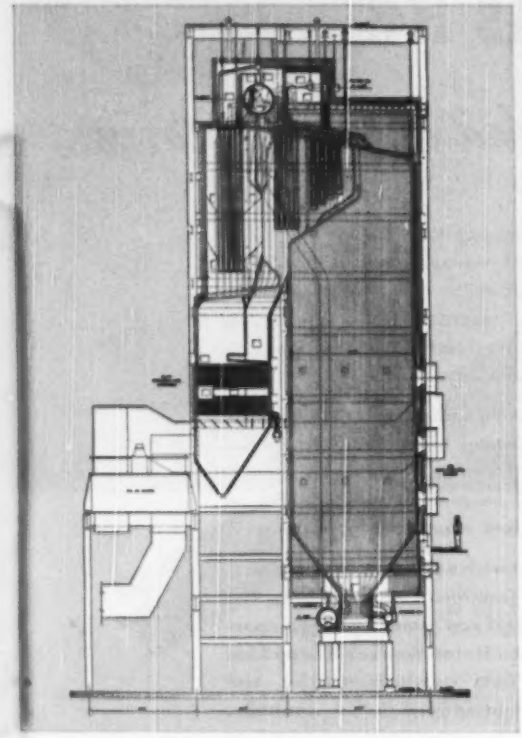


Lapp

LAPP INSULATOR COMPANY INC., LEROY, NEW YORK

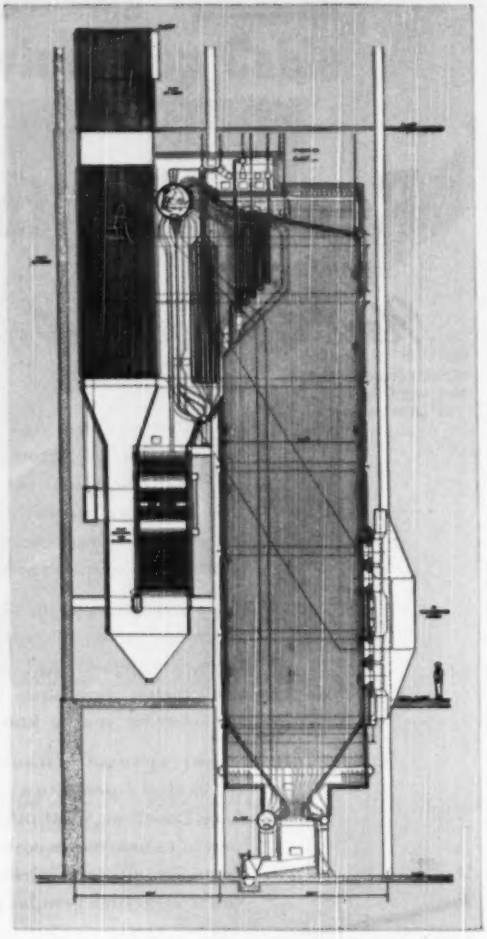
all across the country, Public

THERE is a very noticeable swing among Public Utilities to Riley Steam Generating Equipment. More and more Public Utility Companies are making their initial installation of Riley equipment and those companies who have tried Riley equipment are, almost invariably, coming back for more Riley units when expanding capacity.



JORDAN STATION, Utah Power & Light Co.
620,000 lbs./hr. 1500 lbs. 955°F. Riley Unit
Bechtel Corporation, Consulting Engineers

Utah Power & Light Co. has also installed a 400,000 lbs./hr. Riley unit at their Orem Station and are intalling a 60,000 lbs./hr. unit at Western Colorado Power Co.



R. S. WALLACE STATION, Central Illinois Light Co.
600,000 lbs./hr. 950 lbs. 910°F. Riley Unit

This is the fifth Riley unit to be installed at this station. Four 300,000 lbs./hr. Riley units have been previously installed.

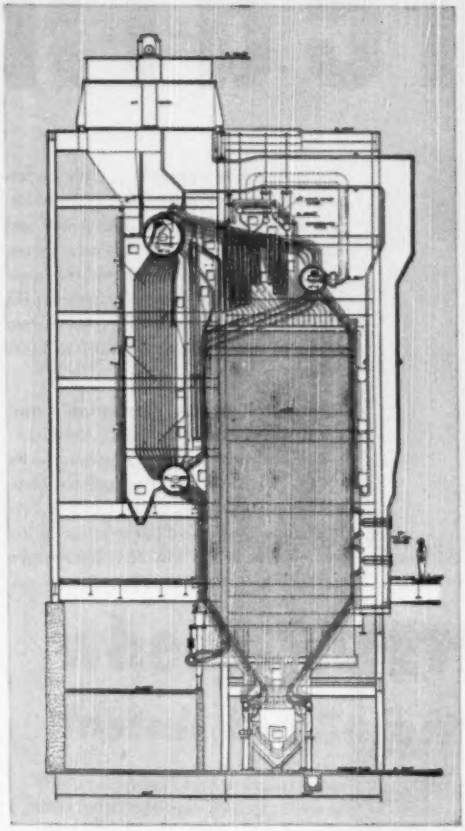
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans Memphis St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

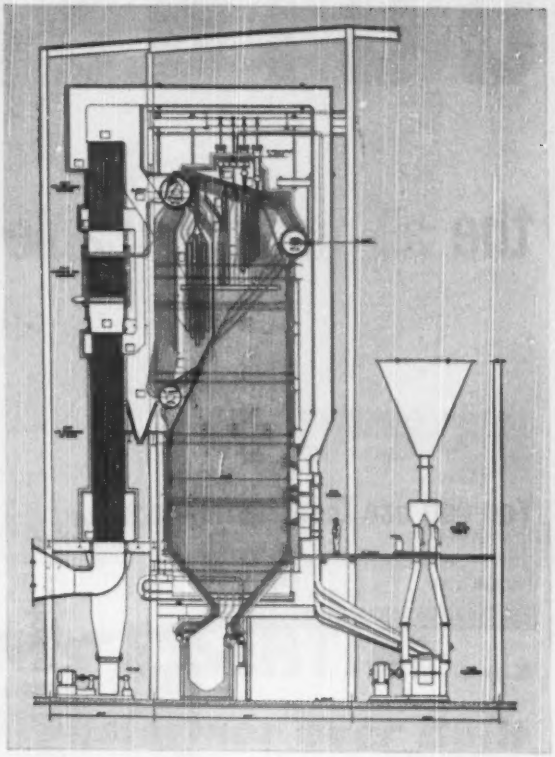
BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Utilities are SWINGING to Riley Units



EDWARDSPORT STATION, Public Service Co. of Ind.
400,000 lbs./hr. 1000 lbs. 910°F. Riley Unit
Sargent & Lundy, Consulting Engineers

Public Service Co. of Indiana has installed Riley units at Dresser and Noblesville stations also—six Riley units, total capacity 2,000,000 lbs. of steam per hour. An additional unit is on order for the Edwardsport station.



RIVERTON STATION, Northern Virginia Power Co.
350,000 lbs./hr. 1100 lbs. 900°F. Riley Unit
Sanderson and Porter, Consulting Engineers

You Can Rely on Riley

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large ... costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

durasheath

the all-purpose cable

Durasheath Is Versatile . . . It's Underwriters' approved for 600 volt underground services . . . Use it in power and lighting circuits, industrial plants, mines, airports, housing developments and farms —wherever your power distribution calls for cable . . . large or small . . . in one, two or three conductors . . . from 600 to 8,000 volts.

Durasheath Is Safe, Dependable and Economical . . . Durasheath* resists corrosion and extremes in temperatures. Its tough Neoprene jacket eliminates electrolysis and resists oil, flame, abrasion, cutting, impact . . . as well as moisture, acids and alkalies in the soil. It is lightweight and flexible—reduces installation costs.

You can use Durasheath—overhead . . . down a building . . . and in the ground—in one continuous run.

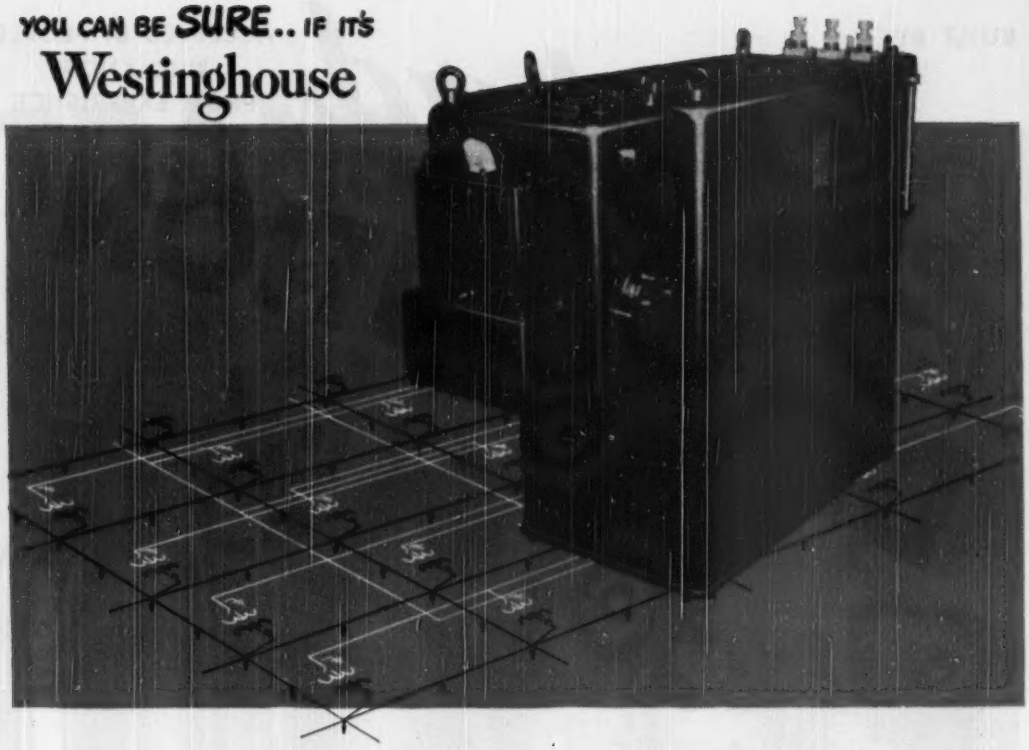
LEARN THE FULL DETAILS of how and why Durasheath can do a more efficient, safer power distribution job . . . and at lower costs! Contact your nearest Anaconda Sales Office or Distributor today. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

*Reg. U. S. Pat. Off.

the right cable for the job ANACONDA® WIRE AND CABLE

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



where SAFETY is ESSENTIAL...

install the Safest Transformer ever Built

When network transformers must be installed in areas where people gather . . . or where extreme conditions of dust, corrosion or water exist . . . wherever conditions are too severe for other transformers, install a Westinghouse Sealed Dry-Type Transformer. It's economical, too, because vaults may be eliminated.

No matter what type of network system you plan, or what your installation problems may be, Westinghouse can help you keep costs down . . . now . . . and in the future.

HERE'S WHY:

Now—There is a Westinghouse Network Transformer specifically designed to answer each of your network problems. In addition to SEALED DRY-TYPES, there are "ASL" VENTILATED DRY-TYPES, ideal for indoor service; LIQUID-FILLED (oil or Inerteen®), most economical for general use; and TYPE "S", pole-mounted to bring network advantages to less dense areas. Standardized construction provides lower initial cost and lower installed cost, too. Special hook-up problems are eliminated.

And in the future—Years of leadership in the design and construction of network transformers show in the high quality and maintenance-free operation of Westinghouse Transformers. In addition, our complete facilities . . . engineers and calculating boards . . . are available to help you in your network planning, to make future expansion more economical.

Ask your Westinghouse representative for further information, or write for Booklets B-4082 and B-4002-A. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70558

Westinghouse

NETWORK TRANSFORMERS

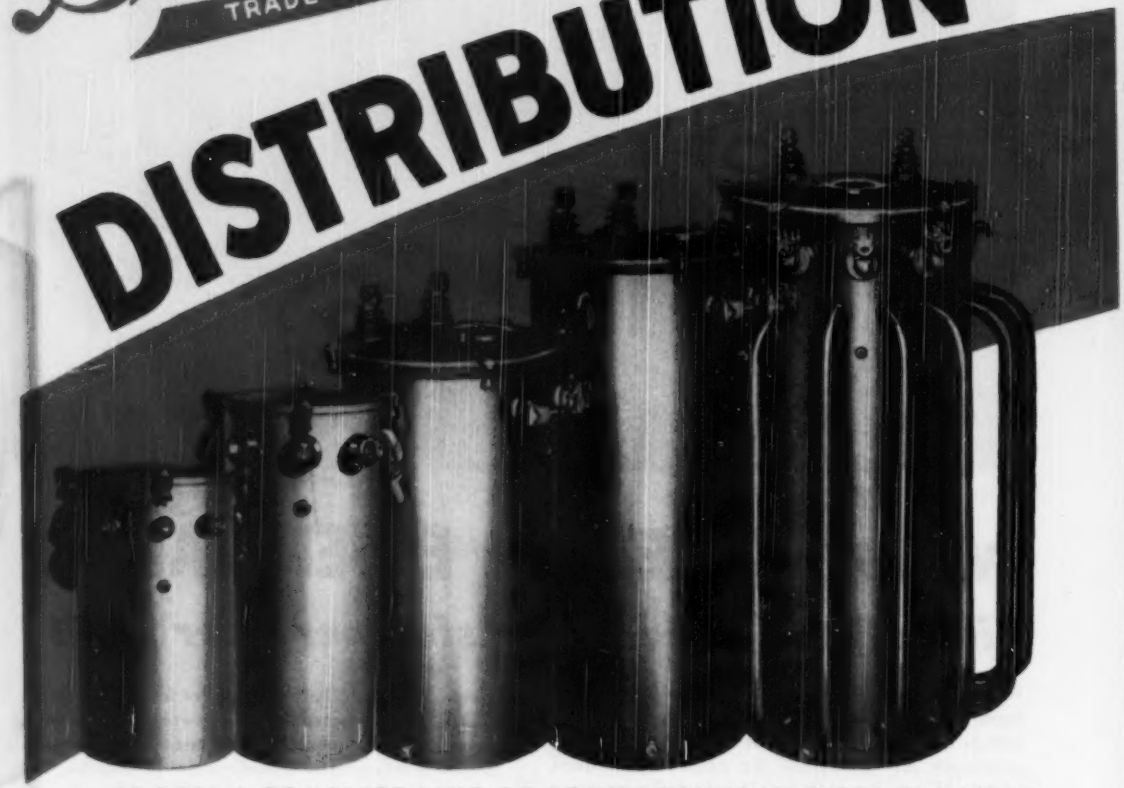
BUILT BY

Standard

TRADE MARK ®

ACCEPTED BY PEOPLE WHO KNOW FROM EXPERIENCE

DISTRIBUTION

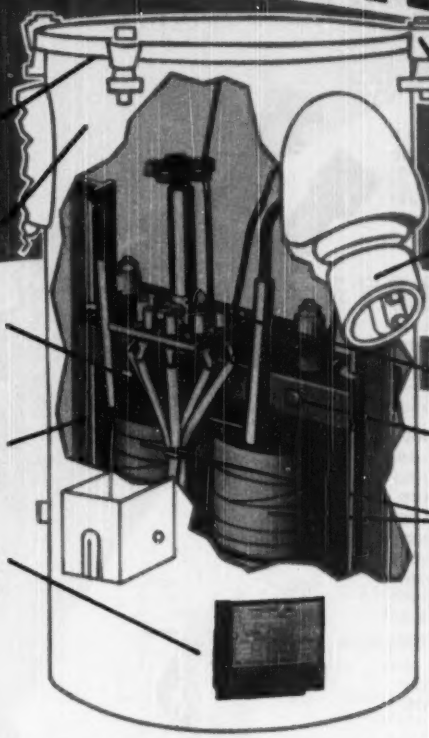


NOW A COMPLETE LINE OF ROUND TANKS IN SIZES THROUGH 100 KVA FOR POLE OR CROSS-ARM MOUNTING . . . . .

- **Heat dissipated twice as fast because of:**
  - (1) Greater coil surfaces
  - (2) Freer circulation of oil
- **Greater protection to transformer because of:**
  - (1) More clearance and insulation to prevent flash-overs
  - (2) Coil impregnation with elastic varnish
- **More durability of tanks because of:**
  - (1) Fabrication from heavy copper-bearing steel
  - (2) Butt-lapped and welded for strength and leak-proofing
- **Cylindrical design because of:**
  - (1) Convenience in handling and installation
  - (2) Better appearance of installations

All Standard transformers are built to or above requirements of EEI, NEMA, ASA and AIEE. Stock or special designs for your specific requirements may be had from STANDARD in STANDARD's proven quality.

TRANSFORMERS



3 Core assembly of non-aging, low-loss, varnish coated silicon steel sheets, sheared and annealed to reduce core losses.

4 Steel T-bars welded to tank for easy insertion or removal of element assembly. Prevent movement in tank.

5 Name plate pad positioned and designed in accordance with ASA standards. Space provided for users plate.

...changing switch.

9 Well-designed core clamping assures quiet and efficient operation.

10 Coil wound in two sections doubles heat radiation. Ends not blanketed, thus inducing free and effective oil circulation.

WRITE FOR BULLETIN S-401A

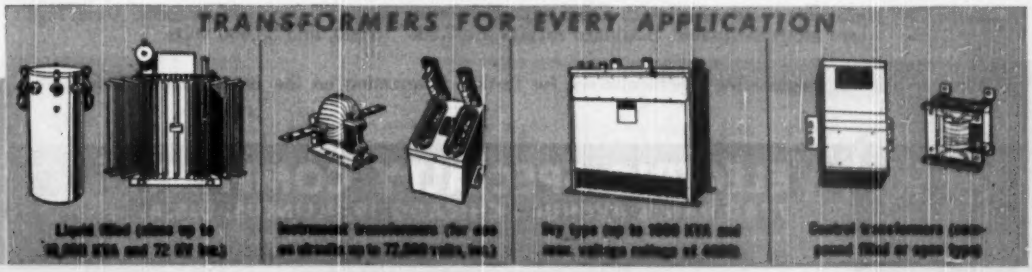
STANDARD's major contribution to the industry has been in the field of special design for difficult specifications. This experience assures you of maximum know-how that, when applied to distribution transformers, provides extra quality.

The extent of our representation affords you rapid answers to transformer problems — write today for the name of your near-by Standard representative. He is qualified to give you information on any type transformer and our service.

Offices in Principal Cities

THE STANDARD TRANSFORMER CO.

WARREN, OHIO



NOW! VOIDLESS COMPOUNDING *PLUS* EASE OF INSTALLATION

The NEW Shape "A" 3 Conductor POLE TOP Pothead

VOIDLESS COMPOUNDING

Proper compounding eliminates trouble-making voids in the body of the shape "A" pothead.

After assembly, a special reservoir is attached to the pothead and heated compound is poured until the pothead and reservoir are completely filled.

The large reservoir holds ample compound to fill any space left by shrinkage as compound cools—and the reservoir is designed so compound is forced into every crevice in the pothead body.

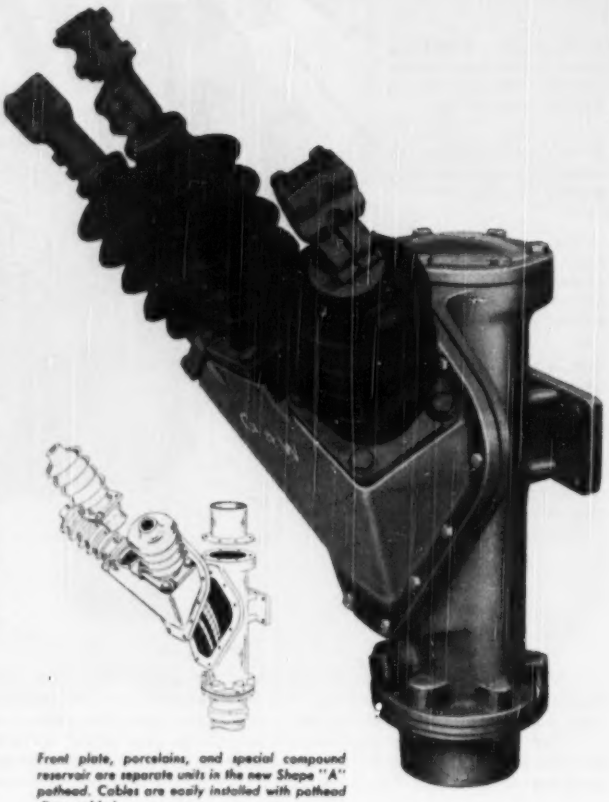
EASE OF INSTALLATION

For the first time the shape "A" pothead can be completely disassembled to permit quick and easy cable connection. Individual porcelains and entire front plate are separate removable units. The large opening in the front of the body permits easy training of cable conductors and arranging them in proper phase relationship. Before assembling the lid with porcelains, the conductors are cut to correct length, connectors attached, and stress relief cones applied.

"Resistoyl" gaskets on all joints insure full protection for your cable terminations.

SHAPED FOR PROPER CLEARANCE

The slope of porcelains in this 'pole-top' pothead provides proper clearance from live cable ends to ground. No bends in conduit risers are needed to get proper clearance when pothead is mounted on pole-tops or grounded structures. Cables fan out properly for best external connection.



Front plate, porcelains, and special compound reservoir are separate units in the new Shape "A" pothead. Cables are easily installed with pothead disassembled.

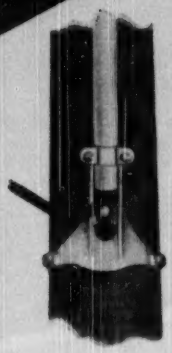
Shape "A" potheads are furnished with either wiping sleeve or stuffing box cable entrances. Aerial lugs are interchangeable. Standard ratings are 7,500, 15,000, and 23,000 volts.

Write or ask our engineering representatives for further information on the new Shape "A" pothead.

G & W ELECTRIC SPECIALTY COMPANY.
7780 DANTE AVENUE • CHICAGO 19, ILLINOIS, U.S.A.
Representatives in principal cities. In Canada, Powerlite Devices, Ltd., Toronto

Streamlined

UPSWEEP BRACKET FOR STREET LIGHTING



Keyhole Mounting Slot

One Man Installs on Pole

1. **SIMPLE**—Four-foot or six-foot 1¼" pipe clamped with stainless steel bolts to malleable iron pole plate casting.
2. **STRONG**—Strength adequate to support a man—tests on 4-foot bracket showed only ½-inch permanent set under 250-pound vertical load; a 6-foot bracket tested ⅜-inch permanent set with 175-pound vertical load. Tests made at higher loads demonstrate that pole plate develops full strength of pipe.
3. **STREAMLINED**—No bracing required; appearance thereby improved.
4. **STURDY**—Liberally designed hot-dip galvanized pole plate with strong clamp.
5. **SMALL**—Requires less pole space; may be mounted near top of pole or at any desired height.
6. **EASY TO INSTALL**—Keyhole slot in pole plate enables one man to attach bracket assembly to pole.
7. **INTERCHANGEABILITY**—Available for use with slip-fitter-mounted luminaires (as shown, with Joslyn Permalux) or with end fitting for top-mounted luminaires.
8. **PRICED RIGHT TO PROVIDE STRONGEST, SIMPLEST, AND BEST BRACKET AT LOW COST.**

Associations in principal cities

THE JOSLYN CO.
THE SOUTH EAST JOSLYN CO.
SOUTHERN JOSLYN CO.
JOSLYN SOUTHWEST CO.
JOSLYN PACIFIC CO.

JOSLYN MFG. AND SUPPLY CO.

Complete Pole Line Equipment

20 NORTH WACKER DRIVE, CHICAGO 6, ILL.

SHORT-CIRCUIT YOUR CABLE TROUBLES

Prevent CORONA DISCHARGE · SHOCK HAZARDS · RADIATION

ON-THE-GROUND SERVICE

PS Shielding assures maximum safety when cables must withstand brutal service like this.

AERIAL SERVICE

PS Shielding prevents radio and television interference when cable must be used near residences. Photo shows how easy it is to make a right angle bend with aerial cable.

LONGER LIFE

When insulated cables are used to eliminate tree trimming, PS Shielding means longer cable life. Because it clings *tightly* to the insulation, and eliminates gaps that cause corona discharge.

with PS Shielding

What it is—PS Shielding consists of a fibrous tape coated with a conducting rubber. This tape is vulcanized to the surface of the conductor insulation. It may be used next to the conductor or over the outer surface of the insulation in contact with the usual shielding tape, ground wire or conducting sheath.

Each conductor in these cables is separately insulated. And each conductor is separately *shielded* with PS Conducting Tape... your guarantee of long-life service and safety.

What it does—Type PS Shielding eliminates many of the weaknesses of metal shielding. For when a cable is bent and straightened, *metal* shielding tends to separate from the insulation. This forms an air gap that causes spark discharge with corona and ozone formation. But Type PS Shielding remains flexible. It clings tightly. It eliminates those destructive air gaps.

Proven performance—

To prove just how effective PS Shielding is, we drove *spikes* through the shielding into the conductor *without* touching the ground wires. In every case, the overload breakers tripped. Proving that PS Shielding *by itself* is an effective safety measure.

PS Shielding was developed by the American Steel & Wire Company. And it has proved so effective that other cable companies have been licensed to use the same construction. It is most widely used for portable power cable, aerial distribution lines and heavy power cable wherever voltage discharge will cause damaging corona and resultant television interference.

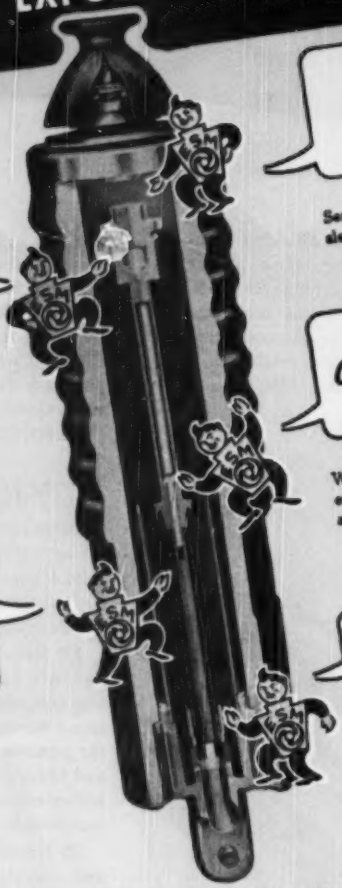
PS Shielding is available applied to both single and multiple conductor cables, sheathed to meet many different applications. Write for complete information.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS **American Electrical Wire and Cable**

UNITED STATES STEEL

PROVED AND APPROVED PROTECTION
KEYSTONE EXPULSION ARRESTER



NO LINE LOCKOUTS

Series gap enclosed; unaffected by sleet, snow or weather.

NO LEAKAGE CURRENT

. . . can flow through fibre arc-quenching element; this eliminates possibility of burning or charring fibre parts.

HIGH SURGE CURRENT CARRYING CAPACITY

Withstands surge current far in excess of NEMA—standard 65,000 amp discharge test.

PARALLEL DISCHARGE PATHS ASSURE LONG LIFE

Less follow current per path; reduces fibre erosion to minimum; which assures longer useful life.

LOW ARC RESISTANCE

. . . prevents complete chopping of voltage wave impressed across transformer insulation. Prolongs insulation life.

New features of construction . . . new technical advances proved in service . . . backed by 57 years of specialized experience in the field of lightning protection—all this adds up to the best there is in expulsion arresters!

The new Keystone expulsion type arrester provides low impulse sparkover and excellent transformer protection . . . high surge current carrying capacity . . . and its many new features assure long life of arresters and transformers.

This is just one of the many new developments by ESM. More are on their way! New technical and instructional data will soon be available on the basic fundamentals of purchasing and applying lightning arresters. Write today . . . let us put you on the list to receive this series of informative booklets. Yours for the asking . . . no obligation.

ELECTRIC SERVICE MANUFACTURING CO.

1709 CAMBRIA STREET PHILADELPHIA 32, PENNA.

2-WAY RADIO'S *Greatest VALUE!!* TODAY and TOMORROW

with exclusive SENSICON RECEIVER - NOW AVAILABLE in the Dispatcher.

PERMANENT VALUE of ADVANCED DESIGN

The Sensicon Circuit with the Permakay Wave Filter, Statomic Oscillator, Differential Squelch, Capacitance Discriminator, and Thermally Balanced Crystal Oven, all exclusive Motorola developments, has advanced the art to permit practicable adjacent channel operation. Further, it provides the only uncompromised design capable of accepting full modulation on the desired channel, and adaptable to "split-channel" frequency assignments. With *"Instantaneous Deviation Control"* of the transmitter carrier plus the broad nose, steep skirt characteristic of the Sensicon Receiver, you have an advanced design combination which will give superior performance *now and tomorrow!*

RELIABILITY

Put it in and forget about it! It breezes along with peak performance always. With fixed-tuned, sealed circuits, precision compensated elements, quality components and workmanship—the day of radio tinkering is over! Remember! the Sensicon System is *coasting* while ordinary systems using fewer tubes are taxed to the false-economy limit!

UNIVERSAL PACKAGING

Built for quick and easy installation—with full accessibility, *here is the solution* to any mounting problem in any type of vehicle. Choice of new all-in-one front model, or trunk mount unit—both are drawer-type with quick lift cover. Both units provide for complete metering and antenna alignment through the covered ports on front—yet the complete housing is closed against dust or other foreign particles.

ENDURING ECONOMY

A quality communications unit designed to deliver longer sustained service at the lowest operating cost. New single vibrator power supply provides for minimum tube and vibrator replacement.

FREEDOM FROM OBSOLESCENCE

The growth of land mobile services licensees from 5,000 in 1945 to over 17,000 (over 160,000 transmitters) today indicates that channel-splitting is imminent. With adjustable modulation control, I.D.C., and exclusive exchangeable Permakay filter you have every factor in hand for your future protection.

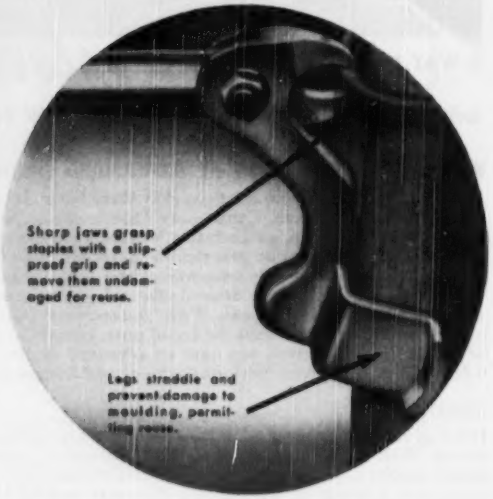
Motorola

4545 Augusta Blvd., Chicago 51 - in Canada: Rogers Majestic, Ltd., Toronto

MADE BY THE WORLD LEADERS IN 2-WAY MOBILE RADIO BACKED BY 20 YEARS RESEARCH, EXPERIENCE, AND SPECIALIZATION IN MOBILE RADIO

CRESCENT'S NEW STAPLE PULLER

SAVES TIME, MUSCLE, MATERIALS!


Sharp jaws grasp staples with a slip-proof grip and remove them undamaged for reuse.
Legs straddle and prevent damage to moulding, permitting reuse.

● This new Tool makes it easy to remove ground wire moulding from poles . . . and salvage both staples and wood moulding, undamaged. Like all Crescent Linemen's Tools, No. 15 Staple Puller is practical in design, well-balanced, and ruggedly constructed. The long handle provides powerful leverage which makes operation easy and fast.

Order from your regular supply source or write us.

Crescent's No. 15 Staple Puller is constructed of drop-forged steel, carefully heat-treated. Handle of black, ribbed rubber, bound at both ends with brass ferrules, and equipped with carrying and hanging ring. Rust-resisting, cadmium plate finish; overall length, 20"; shipping weight, 3-3/4 lbs.

EVERYBODY RECOGNIZES QUALITY } by this Trade-mark

"Crescent" is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

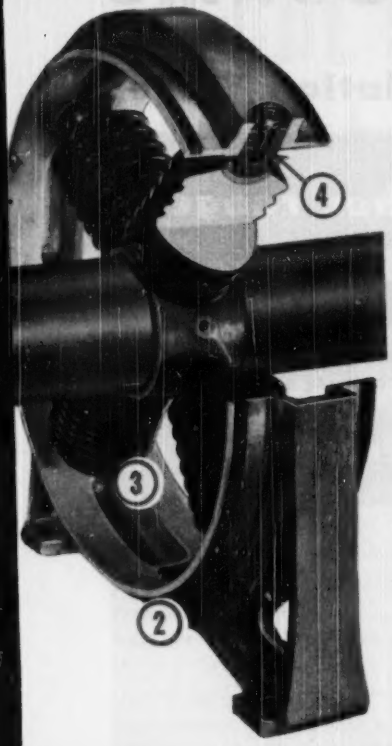
RELIABILITY • SAFETY FLEXIBILITY

with

R&IE

BUS STRUCTURES

METAL ENCLOSED, ISOLATED PHASE



1 PHASES individually isolated and enclosed eliminating costly building and cell construction. Sealed dust-proof with bolted seams. Any section of cover can be opened for inspection.

2 SUPPORT RINGS equalize all stresses. Channel shaped for high strength. May be mounted any position.

3 INSULATION—Porcelain, always in compression—conductor shockproof, longitudinally and radially.

4 INSULATOR ADJUSTMENT — threaded stud with locking nut and washer.

I-T-E

Above is shown a portion of the 11.5 KV. Isolated Phase Transformer leads installed for Pennsylvania Electric Co. at Warren, Pa.
Check all these advantages of isolated Phase, Metal Enclosed Bus Structures against cable runs or cell structures. Then call in an R&IE, or an I-T-E engineer who can discuss details for your installation.

R&IE

RAILWAY and INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

AFFILIATED WITH THE I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.
IN CANADA — EASTERN POWER DEVICES LIMITED, TORONTO

The Check List

CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS

DISCONNECTING SWITCHES INDOOR AND OUTDOOR

HORN GAP SWITCHES

INTERRUPTER SWITCHES

CUTOUTS AND THERMO-RUPTERS

DISTRIBUTION EQUIPMENT

SWITCH OPERATING MECHANISMS

SUBSTATIONS

OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES

KIRK INTERLOCK SYSTEMS

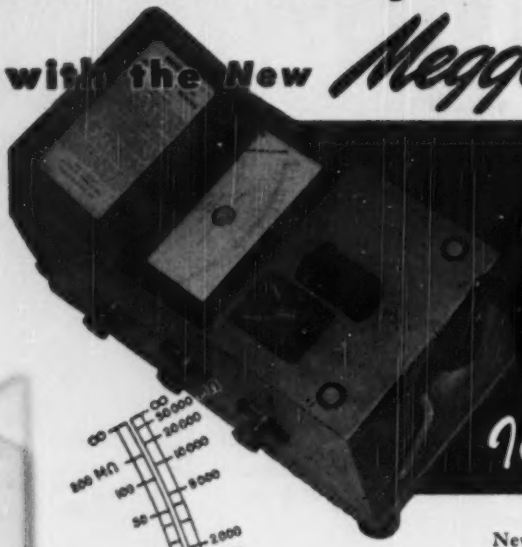
AUTOMATIC RECLOSING EQUIPMENT

METAL CUBICLES

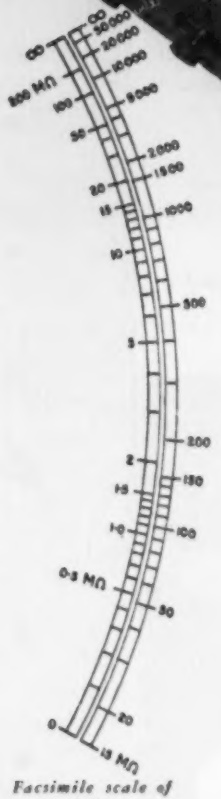
TESTING DEVICES

UP TO 50,000 MEGOHMS

with the New *Megger*® Insulation Tester



New Higher ranges
Wider ranges
Longer scales
Improved Mechanical Features



Facsimile scale of 2,500-volt instrument

Never before has the direct-indicating cross-coil ohmmeter been capable of measuring such high values of insulation resistance!

This accomplishment comes at a time when more attention than ever is being focused by engineers on insulation resistance or d-c loss measurements as a practical non-destructive means of forestalling breakdown in electrical equipment.

These new sets also include several important improvements, such as static shielding, improved hand-drive mechanism, and a simplified design for motor-drive with better voltage stabilization.

The new line of MEGGER Insulation Testers is now available in the following ranges:

Volts	Inner Scale Megohms	Outer Scale Megohms
500 volts d-c	0 to 50	3 to 10,000
1,000 volts d-c	0 to 100	6 to 20,000
2,500 volts d-c	0 to 200	15 to 50,000

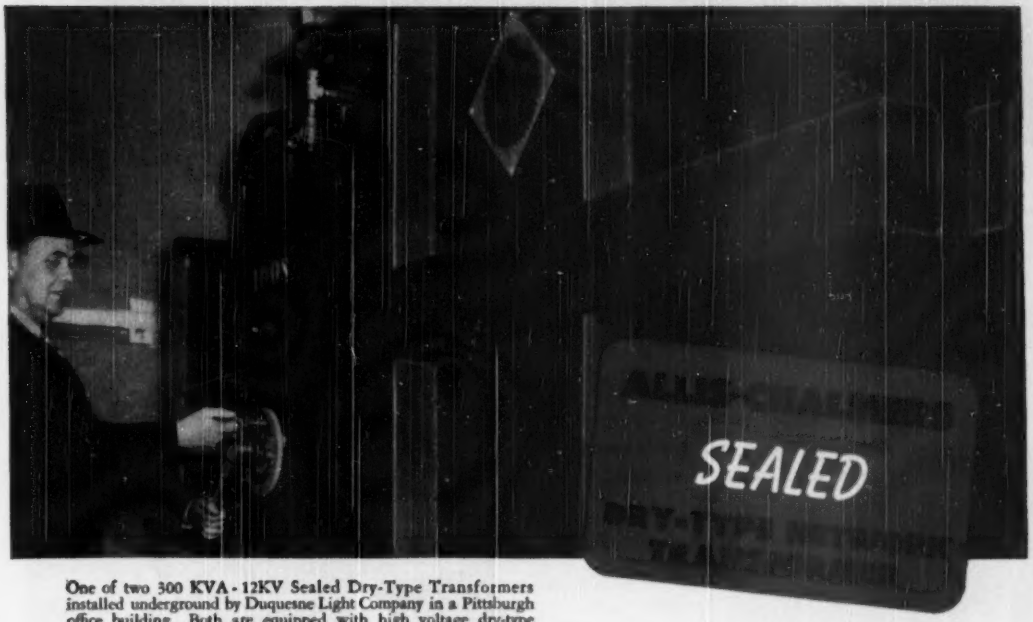
For unusual requirements, a special 5,000-volt instrument is available with range up to 100,000 megohms.

For description and prices, *write for Bulletin 21-20W*

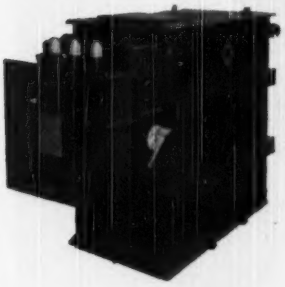
JAMES G. BIDDLE CO.
Electrical & Scientific Instruments
1316 ARCH STREET, PHILADELPHIA 7, PA.

"Megger"® INSULATION TESTERS • GROUND TESTERS • OHMMETERS

Vault Cost Cut, Internal Maintenance Eliminated



One of two 300 KVA - 12KV Sealed Dry-Type Transformers installed underground by Duquesne Light Company in a Pittsburgh office building. Both are equipped with high voltage dry-type disconnect and grounding switch.



Sealed Transformer of the type installed by *Duquesne Light* in downtown Pittsburgh

YOU NOT ONLY operate this transformer with complete safety anywhere, anytime — you can make substantial savings in vault construction as well. This is especially true when separate feeders terminate in the same area. That's because Sealed Dry-Type units eliminate the expense of building either separate vaults or a firewall barrier between the transformers.

These economies are made possible by the fire-and-explosion proof design of Allis-Chalmers Sealed Dry-Type transformers. Core and coils are hermetically sealed in the inert gas-filled tank. This hazard free construction, using Class H silicone insulations with other inorganic materials, lets you make these savings in keeping with accepted safety practices.

MAINTENANCE SLASHED

Internal maintenance is completely eliminated. No liquids to filter or test, no oil gauges or valves to maintain. Repainting is easier too, because there are no cooling tubes, and paint area is reduced 60%.

For information concerning this new Sealed Dry-Type Transformer development, contact your A-C office or write for technical bulletin 61R7395. A-3035

ALLIS-CHALMERS, 932A SO. 70 ST. MILWAUKEE, WIS.

A-3035

ALLIS-CHALMERS A-C ALLIS-CHALMERS

Network Transformers — Nearly 1,000,000 KVA Installed

Nicopress
SUSPENSION DEAD END

1 Faster

2 Neat streamline job when completed

3 Can be made with the same tool used in making a regular line splice

4 The exclusive features found in this Dead End make it possible for it to withstand the most severe conditions

5 Dead Ends are available for Copper, Copperweld and Steel

Nicopress
is the Registered Trade Mark of The National Telephone Supply Company

The National Telephone Supply Company

5100 SUPERIOR AVENUE • CLEVELAND 3, OHIO

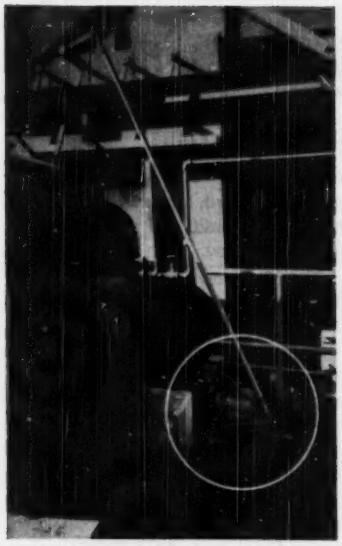
Canadian Mfr.: N. SLATER CO., LTD., HAMILTON, ONTARIO, CANADA

Export Distributor: INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N. Y.

THE NATIONAL TELEPHONE SUPPLY COMPANY

Control panel for one of the 400,000 lb/hr gas-fired boilers at New Orleans Public Service's Industrial Canal Station.

From Btu's to megawatts—
L&N equipment aids plant efficiency



In this semi-outdoors plant, rugged Metermax Electric drive units, like this one (circled) on the induced draft vanes, operate dependably without need for protection from the weather.

The new Industrial Canal Steam Electric Generating Station of New Orleans Public Service Inc. uses L&N instruments and controls at many steps in power production—from firing fuel to distributing power.

Steam-end equipment includes Metermax Combustion Control; Micromax Superheat Control; Micromax Recorders for temperatures of air, water and steam, CO_2, and for condensate purity. On the electrical end are recorders for temperatures of bearings and generators and for frequency, load telemetering and load-frequency control.

In addition to these, we supply the power industry with recorders for smoke density, pH, flow, a-c and d-c voltage and current, power factor and reactive kva.

If you'd like panel engineering service, we're equipped to design and build complete panels, shipped to you fully assembled, wired and tested, ready for installation.

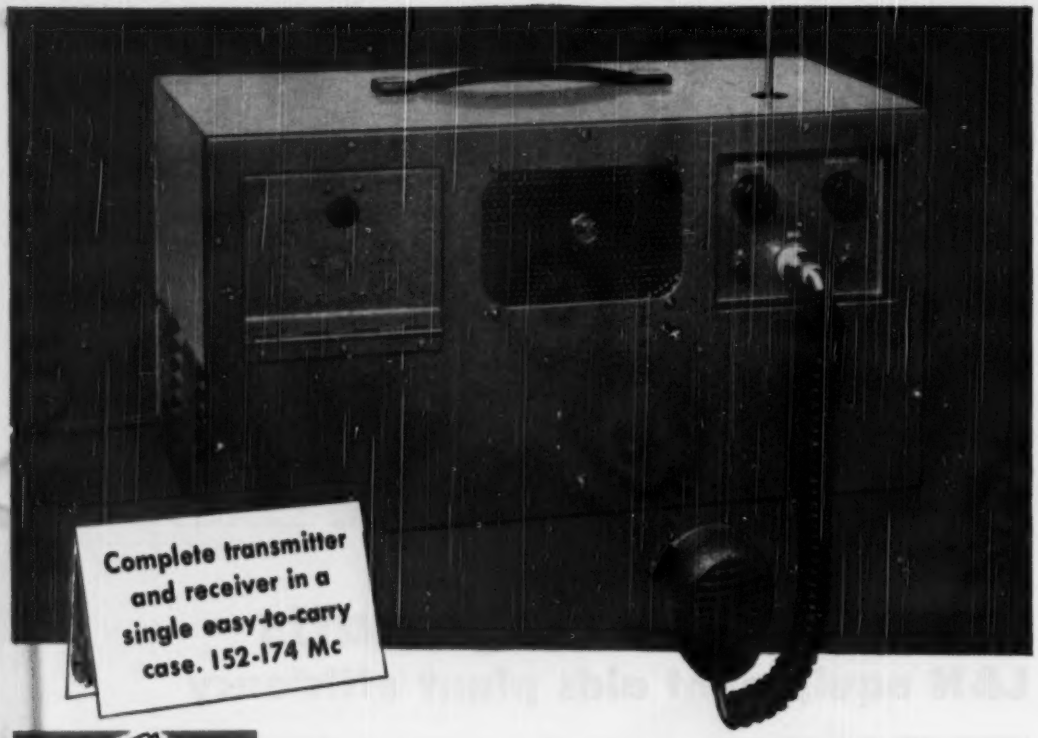
For details, write to Leeds & Northrup Co., 4938 Stenton Ave., Philadelphia 44, Pa.

GENERATOR FIELD TEMPERATURE
GENERATOR STATOR TEMPERATURE
STATION LOAD RECORDER AND TELEMETERING TRANSMITTER
FREQUENCY RECORDER
PROPORTIONAL LOAD CONTROLLERS FOR TWO GENERATORS

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl. Ad N-460(4)



IT'S EASY TO CARRY—weighs only 44 pounds. The case is only 19⅜" long, 10⅜" high, and 9¼" deep.

IT CAN BE SET UP ANY PLACE where there's a 115-volt, a-c supply—forestry, utilities, construction projects, etc.

IT'S IDEAL for 2-way operation (police, fire, etc.) in small and medium-size municipalities requiring medium-range communication equipment.

For *portable or fixed* station use

. . . the RCA Carfone Station Unit "15"

THIS is the most versatile 2-way radio station ever designed for medium-range communication. It is complete with transmitter, receiver, power supply, portable antenna, handy microphone, and loud speaker—*all in a single package.*

Easy to carry and easy to set up, this portable unit can be operated wherever there is a 115-volt, a-c outlet.

For fixed station use, place the unit on the operating desk, hook-up the antenna, plug in the power cord, and you're set to go. For portable station use, simply connect the quarter-wave, whip antenna (supplied) and plug in the power cord. No extra components to carry around. No installation expense involved.

Greatly improved receiver selectivity reduces adjacent channel signals well below interference levels. A newly-designed transmitter modulation control enables you to transmit the full signal potential of the transmitter and maintain 100 per cent modulation at virtually all voice levels—*whether you shout or whisper into the microphone.*

For complete information on the new RCA Carfone Station Unit "15", write Dept. 31-E, RCA Engineering Products, Camden, New Jersey.

RCA

MOBILE COMMUNICATIONS SECTION

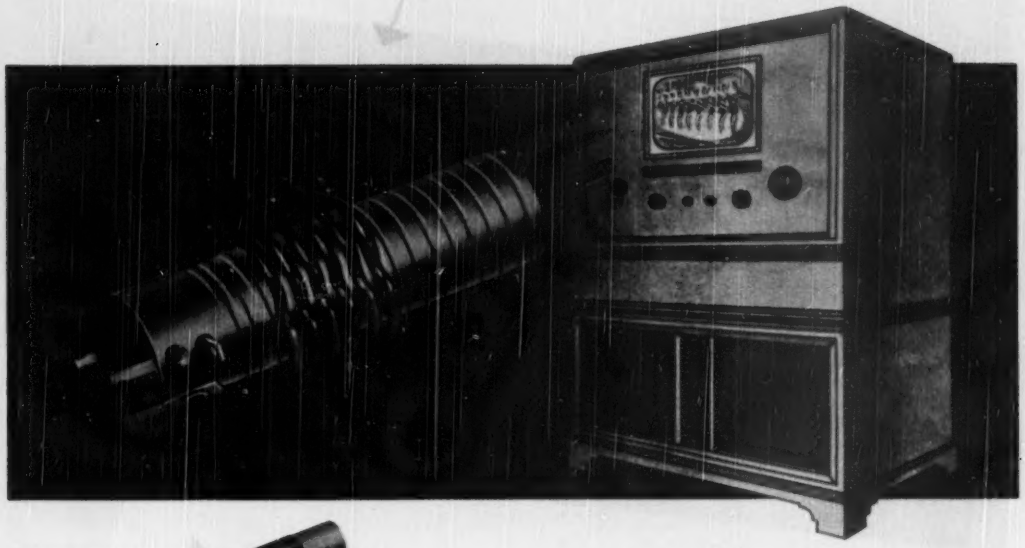
RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

another C-D development . . .

a strong, lightweight, LOW-COST tubing for your electrical applications



Spiral Tubing—one of the many developments that have helped bring television into the mass market. Recently introduced by Continental-Diamond laboratories, it is ideal for electrical, radio, and television applications where a good dielectric tubing with high strength and lightweight is needed. It is available in a variety of sizes and grades to meet requirements for low moisture absorption, forming, riveting, drilling, tapping, etc.

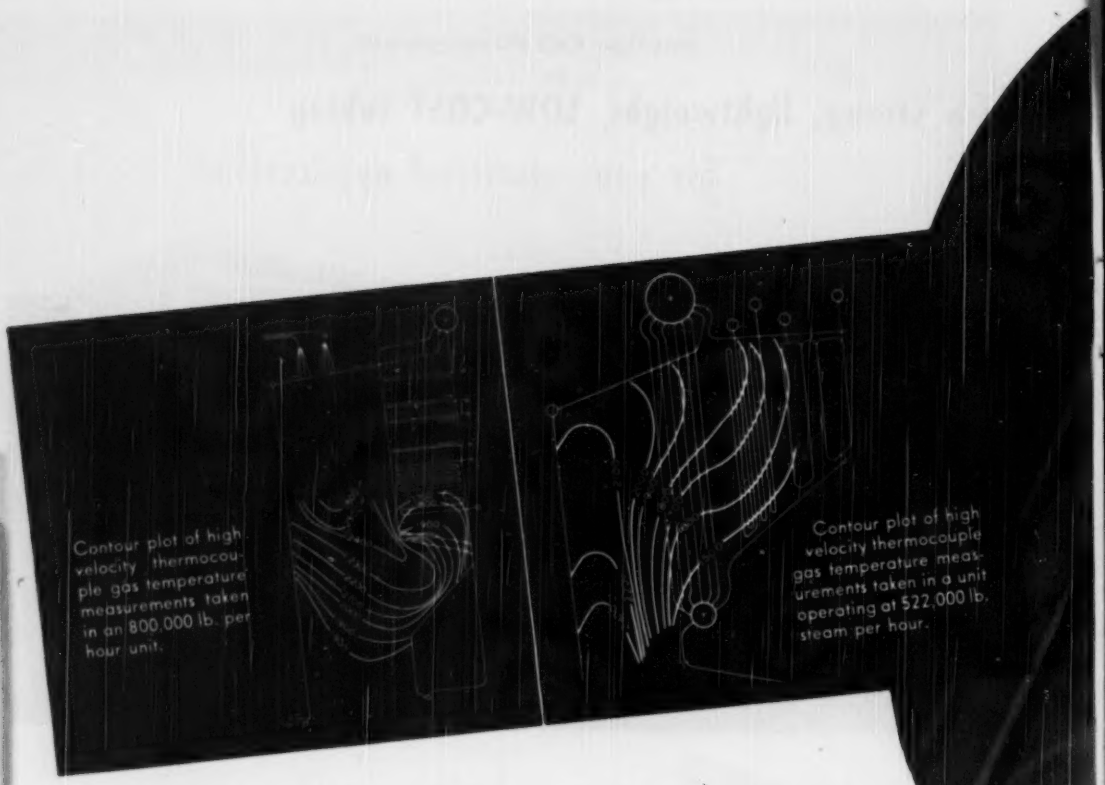
It is another example of why it pays to see C-D first in your search for the right plastic. C-D Plastics provide *practical* combinations of mechanical, electrical, and chemical properties—structural strength, lightweight, moisture, heat and corrosion resistance. For fast delivery, or help with material selection problems, call your nearest C-D office, any time.

EK-5-49

BRANCH OFFICES: NEW YORK 17 • CLEVELAND 14 • CHICAGO 11 • SPARTANBURG, S. C. • SALES OFFICES IN PRINCIPAL CITIES.
WEST COAST REPRESENTATIVE: MARWOOD LTD., SAN FRANCISCO 3 • IN CANADA: DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO 8

Continental Diamond FIBRE COMPANY

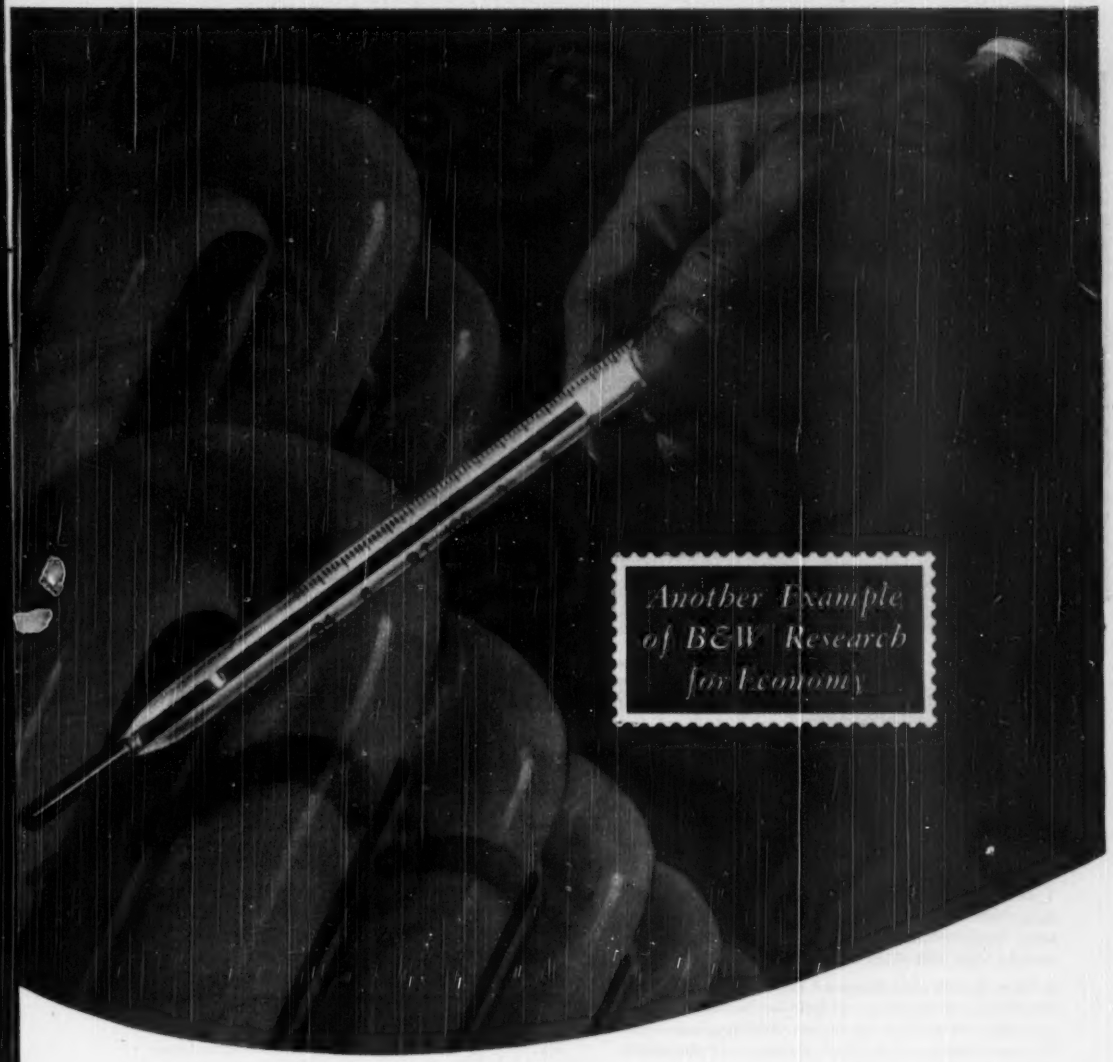
Established 1895 Manufacturers of Laminated Plastics since 1911 — NEWARK 15 DELAWARE


Contour plot of high velocity thermocouple gas temperature measurements taken in an 800,000 lb. per hour unit.
Contour plot of high velocity thermocouple gas temperature measurements taken in a unit operating at 522,000 lb. steam per hour.

Charting Furnace Fever Keeps Power Costs Down

Traditionally, boiler design is an art. As influenced by B&W research, it more and more nearly approaches a positive science. For example, where rules of thumb once determined the design of boiler surface area, now accurate empirical data is available from MHVT research, carried out with the unique B&W-developed multiple-shielded high-velocity thermocouple for precision measurement of furnace gas temperatures.

During several years' intense research, B&W's "MHVT gang" charted the furnace temperatures of nearly a hundred boilers . . . discovering troublesome hot spots . . . determining optimum heat transfer rates under widely varying conditions of service . . . providing B&W engineers with a wealth of design data that assures the highly efficient, trouble-free operation of B&W units. As a direct result of this pioneering work both boiler *size* and boiler



maintenance are kept to the minimum consistent with slagging characteristics of the fuels burned.

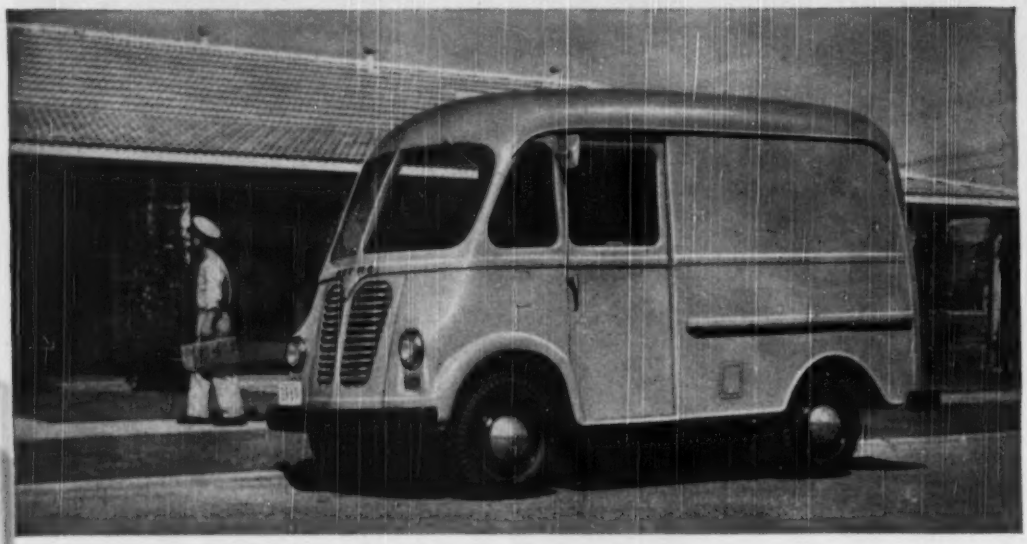
It's this sort of creative research approach to boiler engineering that has identified B&W with steam-power progress for more than 80 years . . . and may well be a source of new steam-generating economies in working out *your* present problems or future plans.

BABCOCK & WILCOX

Helping industry
cut steam costs since 1867

G-491T

Making service calls or making deliveries...



NEW INTERNATIONALS
with *Metro bodies save you money!

Here are 7 reasons why the announcement of new versions of America's most popular multi-stop delivery truck is good news to your pocketbook:

1. New Metro body improvements. Wider front doors, lower floor height, more interior height—Metro body improvements throughout cut loading and unloading time and effort to a minimum.

2. New driver conveniences. New conveniences for the driver mean a better job done for the owner. These conveniences include maximum visibility, easy ventilation control, comfortable seating, and simplified driving control location.

3. New maneuverability and ease of steering. New Metro models thread more easily through traffic, turn in the shortest practical turning circles—thanks to the new steering system and wider-tread front axles.

4. New smart styling. You'll like the looks of the new Metro. New functional styling throughout adds to the unit's advertising value as well as to its usefulness.

5. New Silver Diamond Engine. This new valve-in-head power plant represents a $10,000,000 investment by International in better engine performance. It will pay off for you in new power and economy.

6. New heavy-duty engineered International chassis. Every new International multi-stop chassis is heavy-duty engineered to save you money. This means that the same values that have kept International first in heavy-duty sales for 18 straight years can now cut the cost of your delivery operation by cutting maintenance.

7. New models. Now there are 6 models ranging from 5,400 to 10,000 pounds gross vehicle weight. Metro bodies are 7¾, 9½, and 12 feet long.

Add to this all the traditional Metro advantages and, any way you figure it, you'll be money ahead to find out *more* about new Internationals with Metro bodies. See your nearest International Truck Dealer or Branch.

*Metro. Registered trade mark of The Metropolitan Body Company, Inc., subsidiary of the International Harvester Company.

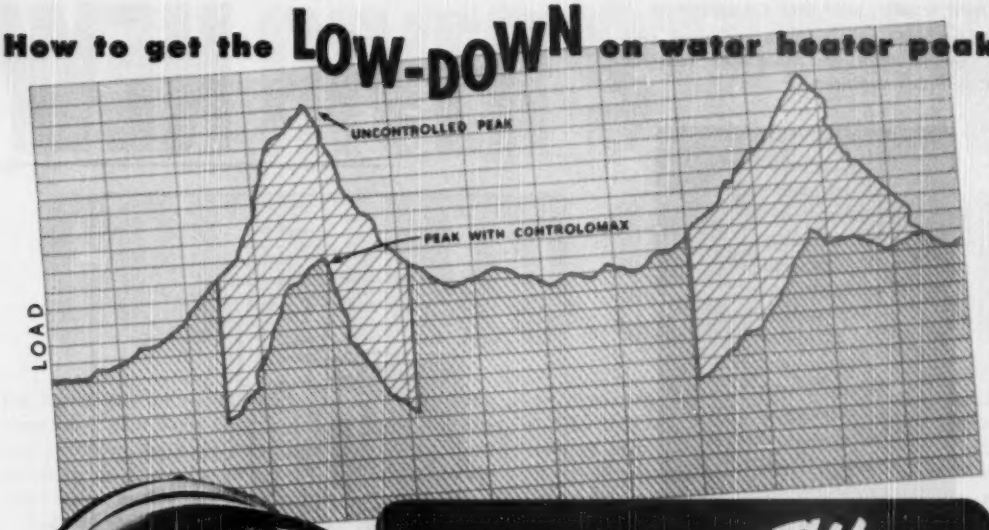
International Harvester Builds
McCormick Farm Equipment and Farmall Tractors
Motor Trucks . . . Industrial Power
Refrigerators and Freezers

Tune in James Melton and "Harvest of Stars"
NBC, Sunday afternoons

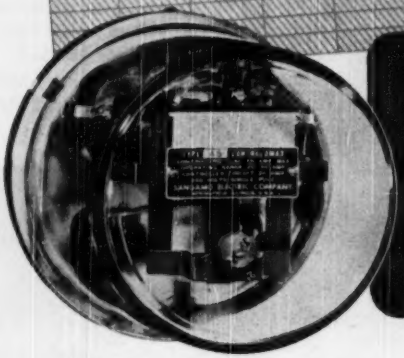
INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY CHICAGO

How to get the LOW-DOWN on water heater peaks



with the NEW SANGAMO CONTROLOMAX



Type AS (Socket) Enclosure

To assure profitable returns from water heater loads, the effect of their demands must not result in costly peaks, as is the case when electric ranges, ironers, clothes dryers or other large current consuming devices are used at the same time water is being heated.

Now, an exceptionally simple control device, the new Sangamo Controlomax, will prevent water heater demands from adding to these peaks. When load currents reach pre-determined levels the water heaters are disconnected. As soon as the load current is reduced to an established level, the water heater is re-connected. Thus, on the basis of consumers' load and use habits, peaks are reduced and long charging periods and low demands will result.

The Sangamo Controlomax is an automatic thermal switch. A bimetallic strip with a slow, positive motion operates a contact. Maintenance will be practically nil. Time settings are unnecessary. The first cost is low, and operating costs are at a minimum.

Now, Sangamo adds to its complete line of time switches and meter-time switch combinations for *time* control of water heater peaks, a simple thermal control based on the *magnitude of the consumer's load*.

Write for bulletins on the complete line of controls for electric water heater loads.

Type AB (Box) Enclosure

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

NEW UTILITY STATIONS C-E EQUIPPED

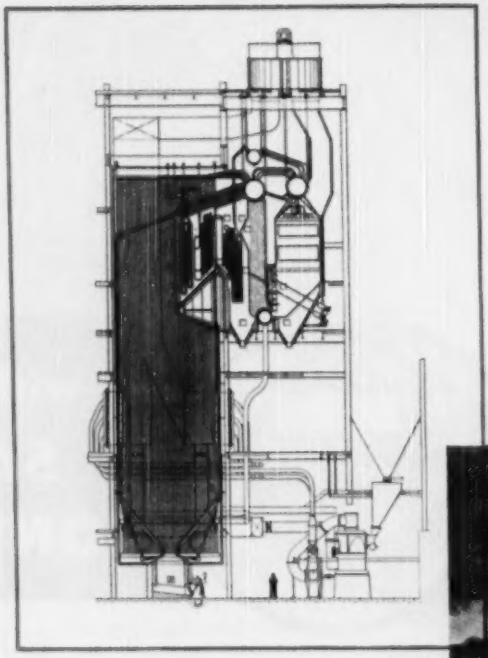
Includes stations placed in operation since the war (in white) and those under construction or being engineered.

NEW

TIDD
JENNISON
CECIL LYNCH
HAVANA
MEREDOSIA
PERMIAN BASIN
O. H. HUTCHINGS
REX BROWN
HICKLING
B. C. COBB
RUSSELL
SEWAREN
POSSUM POINT
PORT JEFFERSON
CUTLER
WHITE RIVER
GADSDEN
POTOMAC RIVER
W. SPRINGFIELD
WOOD RIVER
LAKE CATHERINE
HARRY NEWMAN

DAN RIVER

JIM HILL
HUTCHINSON
DUNKIRK
YATES
HAWTHORN
TITUS
LEE
EDGE MOOR
CONTRA COSTA
PALATKA
NINEMILE POINT
BLACK DOG
CLERMONT
MERAMEC
DANSKAMMER
LONG BEACH



The cross-sectional view above shows one of the two C-E Units now in service at the Dan River Station. They are 3-drum boilers with 3-stage superheaters and have finned tube economizers in the rear pass. Regenerative type air heaters follow the economizer surface. These boilers are designed for pulverized coal firing using bowl mills and tilting, tangential burners. Steam is produced at 1295 psi and 950 F at the superheater outlet.

COMBUSTION ENGINEERING

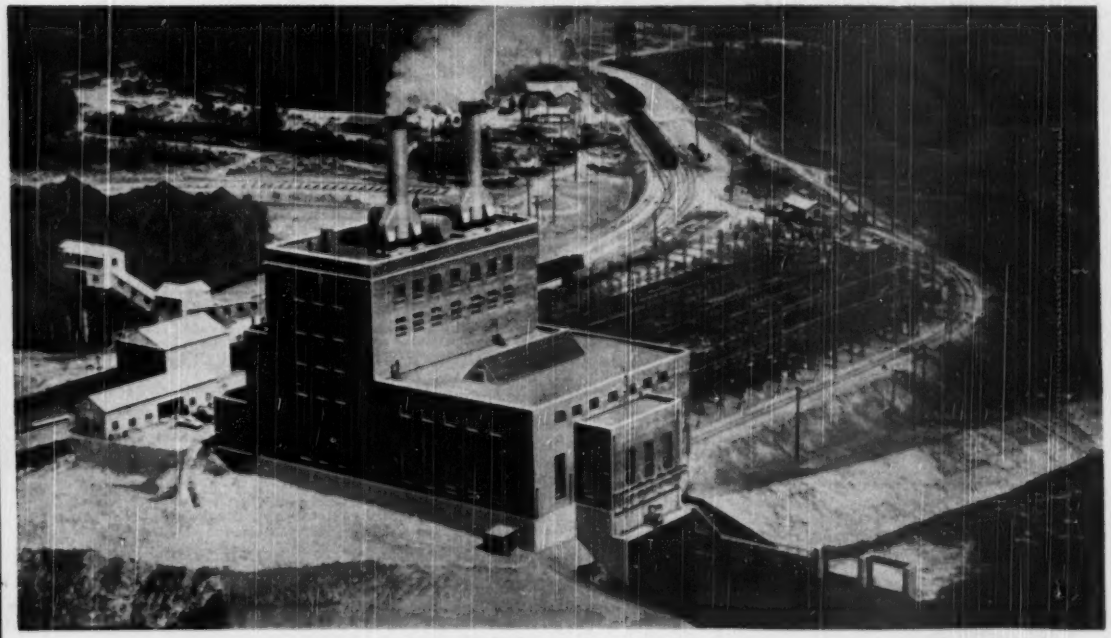
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

DAN RIVER STATION GOES INTO SERVICE

On March 4th the second unit of Duke Power Company's new Dan River Station was placed in commercial operation. Actually, this station began to supply power to the Duke Power system on December 12th 1949 when the first unit went on the line.

Located at Leaksville, N. C. on the Dan River this fine modern station will take its place as an important link in the greater Duke Power system, supplying the growing needs of the Piedmont area of the Carolinas.

The Dan River Station now has two 70,000 kw turbine-generators available for service. Each of these units is served by a single C-E Steam Generating Unit in the increasingly popular one-boiler, one-turbine arrangement. A cross-sectional elevation of one of the new boiler units together with a brief description thereof appears on the opposite page. B-405



— SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.
C-E

NEW SPLICES AND DEAD-ENDS EXCEED STRAND STRENGTH AND CONDUCTIVITY

Recently, one of the best known electrical laboratories* tested the static strength and the d-c resistance of various splices and dead-ends. The engineers found one system far better than the rest. So much better that you will want to see their testing procedure and test results.

HERE'S WHAT THEY DID

7-STRAND CONDUCTOR

They took two sections of $\frac{1}{8}$", 7-strand extra high-strength galvanized steel (catalog strength: 11,200 lbs.)

SPLICE

Spliced them together, *by hand*, with *Preformed Armor Rods*.

*Name on request

DEAD END

Then attached dead-ends of *Preformed Armor Rods* to both ends . . . using no tools, clips or clamps.

DEAD END SPLICE DEAD END

Placed the specimen in a tensile testing machine. Measured the d-c resistance (through both dead-ends and the splice) under no load and under loads up to 5000 lbs. Continued loading until the specimen failed. Compared these results with an unbroken conductor of equal length.

HERE'S WHAT THEY FOUND

Preformed armor splices and dead-ends averaged at least 40% more conductivity than the unbroken cable every time the test was made.

Preformed armor splices and dead-ends proved stronger than the unbroken conductor. Breaks always occured in the section not protected by the *Preformed Armor Rods* . . . at about 10% more than the rated strand strength of 11,200 lbs.

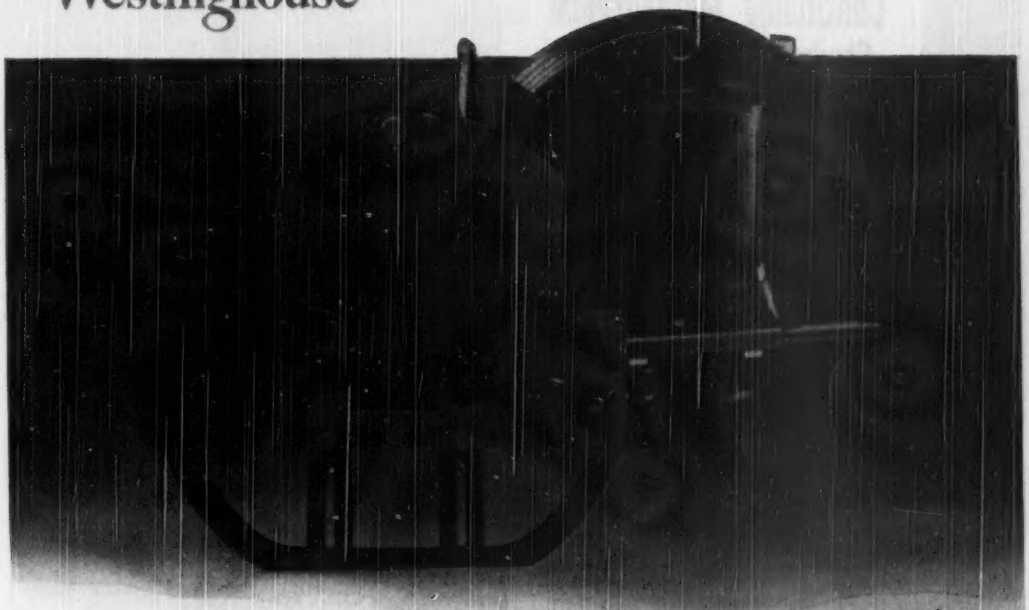
WANT MORE INFORMATION?

Complete test results and other technical information can be had by writing to . . .

PREFORMED LINE PRODUCTS CO.
1051 POWER AVE. • CLEVELAND 14, OHIO

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



IT TAKES FIXED MAGNETIC CIRCUITS

FOR *Sustained Meter Accuracy* *

Magnetic circuits *can't* change when meter core laminations are made in one piece. Only Westinghouse offers this feature. You get *permanent* performance characteristics.

All parts are built integral with the electromagnet. Calibration is not disturbed even when the electromagnet is removed and replaced.

This is the kind of construction that assures SUSTAINED meter accuracy . . . without attention or extra expense.

Important to you in buying meters? Certainly, because it saves you money. Your own records will prove it.

Get the complete story in the new booklet, "What It Takes for Long-time, Low-cost Metering", B-4665. Call your nearest Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-40370

Westinghouse
METERS

A VITAL PART OF LONG-TIME, LOW-COST METERING

Continuing Metallurgical Study Produces Major Savings For Utilities

BACK some ten years ago, Kellogg's metallurgists, working with the turbine manufacturers, discovered that carbon-moly steel, which had been "killed" with less than half a pound of aluminum per ton, could readily be heat-treated at lower temperature to achieve the desired uniform acicular grain size for optimum elevated temperature strength.

This was, naturally, important as the demand grew for piping to withstand operating temperatures up to 950° F. But even more important was the later discovery that this steel showed practically no graphitization at this temperature. As a matter of fact, when graphitization troubles hit the utility industry in general during the early forties, *Kellogg* carbon-moly installations using this steel were found to be unaffected. Obviously this meant a saving of hundreds of thousands of dollars for those utility companies that had followed Kellogg carbon-moly specifications.

Today, to prevent graphitization at even higher temperatures (up to 1050° F.) chrome-moly steels have been generally adopted by the industry for main steam piping.

Functioning in the same pattern as they did a decade ago, Kellogg's metallurgical groups are currently working toward pin-pointing the *minimum amount* of chromium that can be used successfully in high temperature piping.

Specific and continuing development work is one of the many advantages that utility companies gain when they specify M. W. Kellogg high temperature and high pressure piping.

Illustrated — *photomicrograph (500 m.) of specimen indicating presence of graphitization.*

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Vessels
Exchangers
Condensers
Process Piping
Forged and
Welded Fittings
Radial Brick Chimneys

★

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa Houston, Toronto, London and Paris

USERS SAY G.E.'S 9574 ALL-PURPOSE* INSULATING VARNISH "is tops!"

J. L. Hughes

How do users like General Electric's new all-purpose insulating varnish G-E 9574?

Here's a statement from J. L. Hughes, owner of the J. L. Hughes Electric Company, Columbus, Ohio.

> *"We have found from test and practical experience that General Electric general-purpose varnish 9574 is tops for our work."*

Mr. Hughes knows what he is talking about. He has been in the business of motor repair and rewinding in Columbus for thirty-three years.

YES, G-E 9574 OFFERS YOU

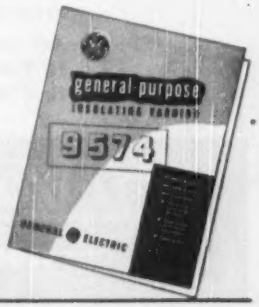
One varnish you can depend on for ALL* jobs.

A Combination of electrical, chemical and mechanical properties formerly found only in special-purpose varnishes.

Easier Handling: Low baking temperature; deep penetration; simple thinning with petroleum spirits.

**G-E 9574 gives excellent results on all types of coils except extra-high-speed armatures. It is one of G. E.'s complete line of electrical insulating materials, including adhesives, wedges, cements, compounds, cords and twines, sleeving, wire enamels, mica, papers and fibers, permafils, tapes, tubing, varnished cloths, and varnishes.*

SEND FOR BULLETIN! If you haven't yet tried G-E 9574, get in touch with your local G-E Distributor, or write for our new bulletin to Section K1, Chemical Department, General Electric Company, Pittsfield, Massachusetts.



You can put your confidence in

GENERAL ELECTRIC

Assures

BETTER SWITCH PERFORMANCE

The new Hi-Voltage "Silver Bridge" replaces the customary braided shunt at the switch hinge. It consists of one or more pairs of copper bars welded to silver-nickel accurately finished for contact with silver bands at the hinge centers.

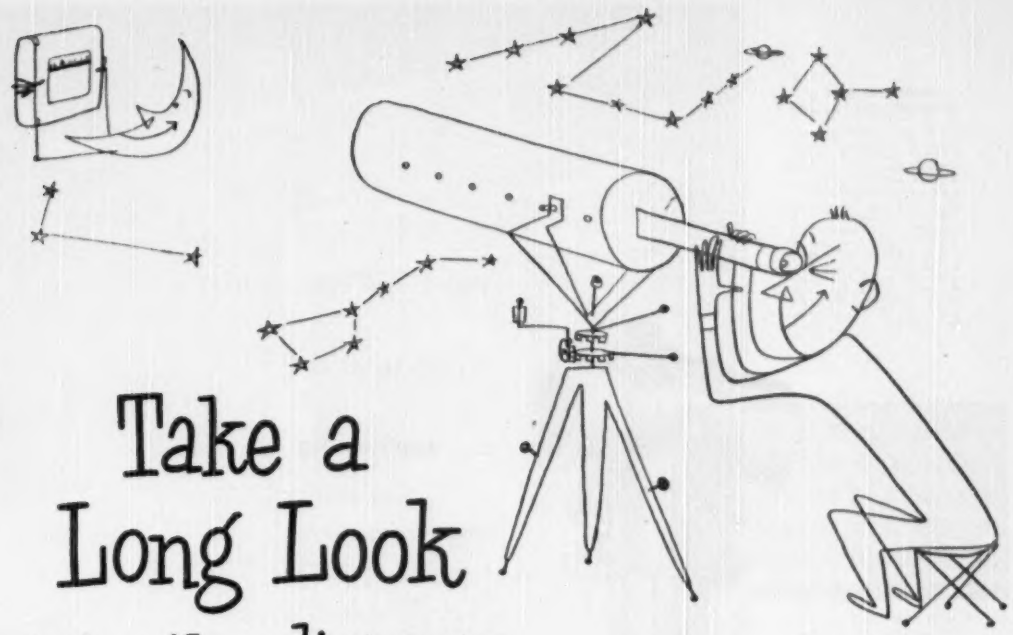
Locked as a self-aligning, non-adjustable unit, contact pressure is maintained by stainless steel compression springs. The silver alloy used at the current exchange surfaces has the permanent low contact resistance of fine silver.

The entire construction is so simple and substantial that it cannot introduce problems of maintenance or operation. For example, the new "Silver Bridge" excludes the second set of make-and-break contacts that have been customary on switches which eliminate flexible shunts. Ease of operation is assured, and the milli-volt drop of the "Silver Bridge" is less than half of a new 600-ampere braided shunt.

Ask your Joslyn Salesman to demonstrate the outstanding advantages of the Hi-Voltage "Silver Bridge". He has a sample that you can examine thoroughly right in your own office.

HI-VOLTAGE EQUIPMENT COMPANY

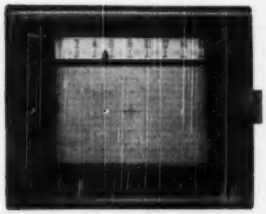
4000 EAST 116TH STREET • CLEVELAND 5, OHIO



Take a Long Look into the distance

and see the facts you need for high efficiency

Bristol's Metameter System of Telemetering gives an accurate, up-to-the-minute account of conditions at remote points . . . enables you to anticipate abnormalities . . . prevent emergencies.



Bristol Strip-Chart Metameter Receiver

Used by load dispatchers of central station systems for readings of:

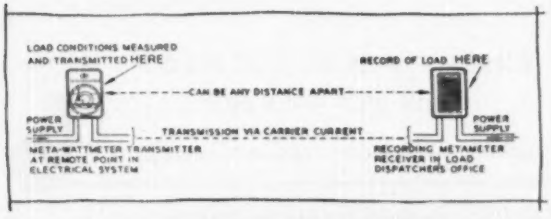
- load at each tie-line point
- output of each generating station
- totalized output (on a single instrument) of all generating stations
- active and reactive power and power demand at key points
- voltage and current at various points

And by operators of generating stations for readings of:

- output of each associated station —attended or unattended
- total output of generating station
- water level and waterwheel gate position
- water level—reservoirs, surge tanks, etc.

Readings can be transmitted any distance over any two-wire circuit or its equivalent—carrier-channel, telephone, telegraph or radio (including microwave) . . . to recording receivers (narrow or wide-strip chart or round chart) or indicating receivers with illuminated dials.

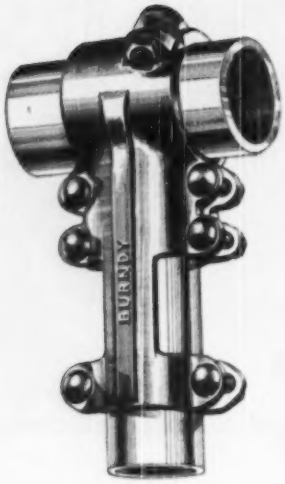
Write us for Bulletin M1700. THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 20, Conn.


LOAD CONDITIONS MEASURED AND TRANSMITTED HERE
RECORD OF LOAD HERE
CAN BE ANY DISTANCE APART
POWER SUPPLY
TRANSMISSION VIA CARRIER CURRENT
POWER SUPPLY
META-WATTMETER TRANSMITTER AT REMOTE POINT IN ELECTRICAL SYSTEM
RECORDING METAMETER RECEIVER IN LOAD DISPATCHER'S OFFICE

BRISTOL

Gives You the FACTS When and Where You Want Them

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



with power connectors,

the character of

the **engineering**

determines the

quality of the product.

This relationship

is best expressed

in the

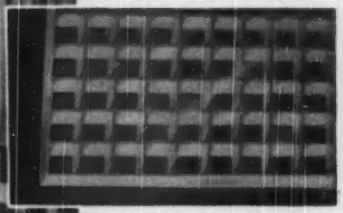
single

word...

BURNDY

A NEW STANDARD OF LIGHT TRANSMISSION

Taste-Testing Room, Kraft Foods Company, Chicago, Illinois. Installation involved three types of recessed troffers made by Curtis Lighting, Inc. The three 40-watt lamp troffers provide an average of 40 F.C.; two lamp 29 F.C. and single lamp, 15 F.C. Recessed incandescent, 200-watt I.P. lamp troffer averages 66 F.C. Averages were calculated by using a coefficient of utilization of .41 and a maintenance factor of 75%. These values were verified by 21 actual readings after 100 hours of burning.



Close-up of FOTA-LITE showing how louvers penetrate full thickness of glass.

Like the Glow from the Northern Sky

Corning FOTA-LITE provides uniform brightness control from both fluorescent or incandescent light sources

In the taste-testing kitchen of Kraft Foods Company, foods are appraised and arranged for color photography and advertising art. A high level of illumination plus exceptional brightness control was desired. A combination of incandescent and fluorescent were found desirable for delicate color control.

To blend the external appearance of both luminaires and use the most efficient and effective material, Corning FOTA-LITE glass was selected. The choice of FOTA-LITE gave excellent footcandle and brightness values. Comparative brightness readings *proved* that FOTA-LITE produced lower values than louvered fixtures or several other types of glass panels in the 45° to horizontal zone. It brought out color contrast with clarity and reality.

FOTA-LITE *is* a remarkable new lighting glass. Diffusing louvers are transmitted into the full thickness of glass by a photographic process. They never lose efficiency for the image is permanent. Light directed vertically remains unrestricted while the diffusing louvers intercept and eliminate glare at the 45° cut-off.

FOTA-LITE permits dust-tight fixture construction. Maintenance is no problem since only a single flat surface need be cleaned. There is almost no limit to its application as it may be used in recessed or pendant lighting fixtures, continuous row or complete luminous ceilings. You can evaluate it best by sending for a sample. Use form below.

CORNING GLASS WORKS

CORNING, NEW YORK

Corning means research in Glass

FOR EFFICIENT, ATTRACTIVE LIGHTING...

CORNING ALBA-LITE for diffusion of fluorescent light ... CORNING FOTA-LITE for high level illumination ... CORNING brand LENS PANELS and PYREX brand LENSLITES for prismatic light control

***FREE*—FOTA-LITE sample on request.**

CORNING GLASS WORKS, Dept. EW-5, Corning, N. Y.

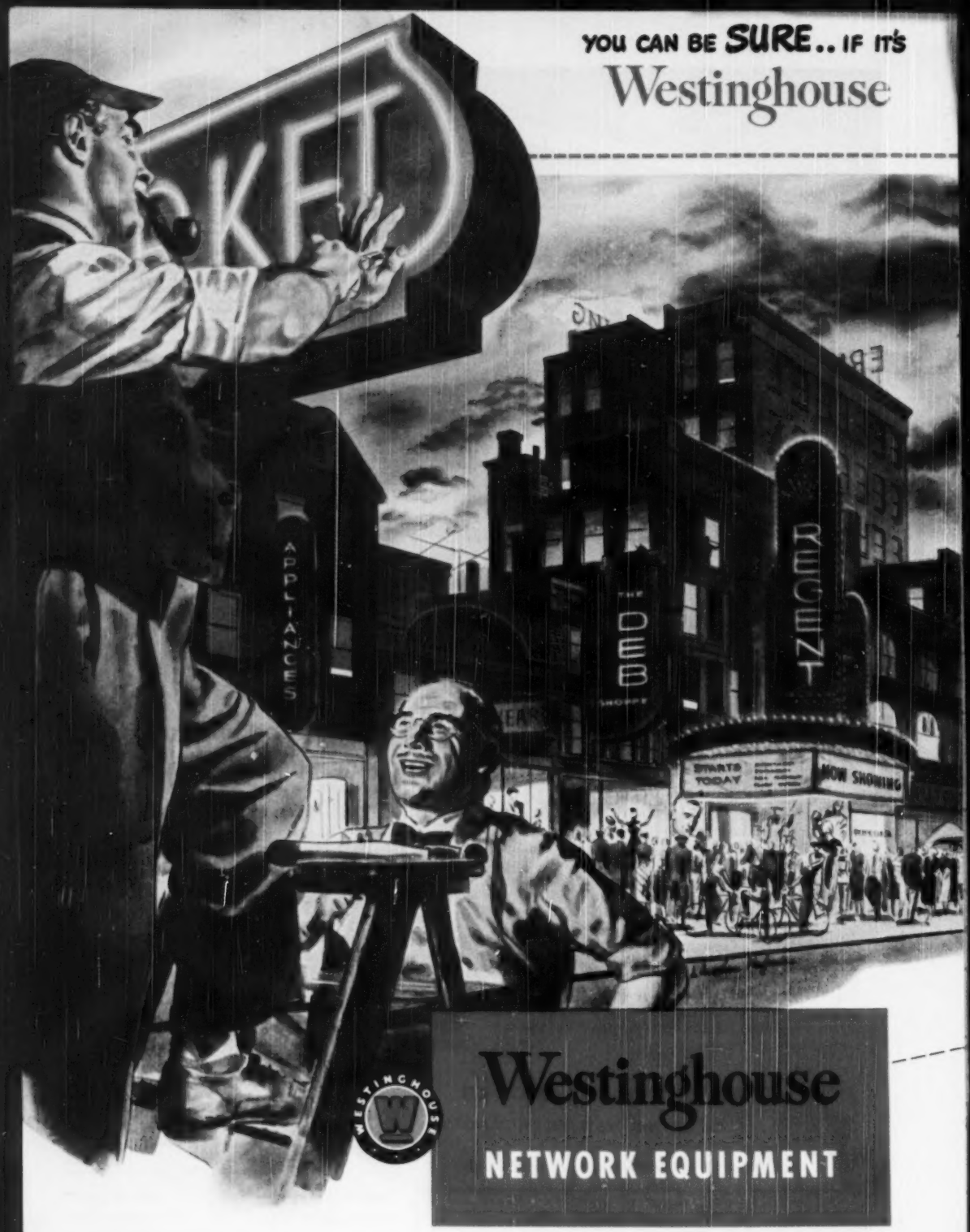
Please send me your FOTA-LITE demonstration card showing how FOTA-LITE diffuses and cuts off light at 45°

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____


YOU CAN BE SURE.. IF IT'S
Westinghouse
KFT
APPLIANCES
DEB
KWOWZT
STARTS TODAY
NOW SHOWING
WESTINGHOUSE
Westinghouse
NETWORK EQUIPMENT

When the shopping center orders more power

...SECONDARY NETWORKS PAY!

Twenty-one percent of all cities in the 25,000 to 100,000 population range enjoy the advantages of a secondary network system! And their number will grow, because . . .

The shopping centers are ordering more power! New lighting, new air-conditioning systems, new business machines . . . in every phase of commercial activity, the load continues to grow.

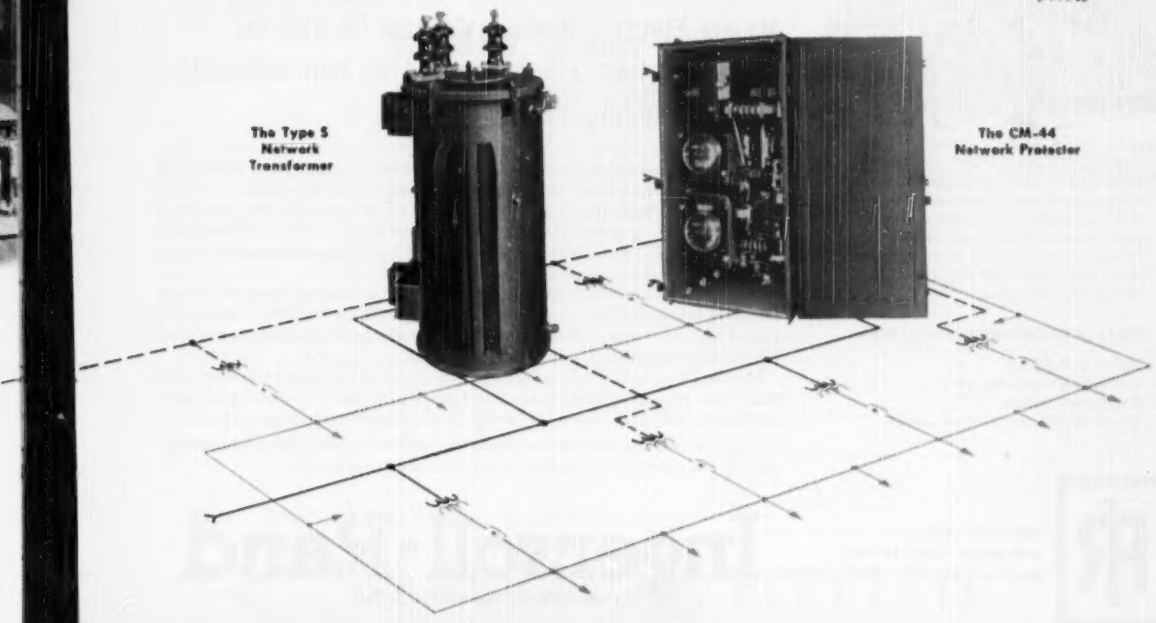
Does your system planning provide the flexibility necessary to meet this demand . . . profitably?

It does if it includes secondary networks . . . for this is the most flexible system ever devised. It permits extensions, load shifts and load growth to be accommodated *economically.* It assures a sharp reduction in operating and maintenance expense . . . simplified layouts . . . the use of less and better co-ordinated equipment. It eliminates the possibility of ultimately arriving at an over-congested condition.

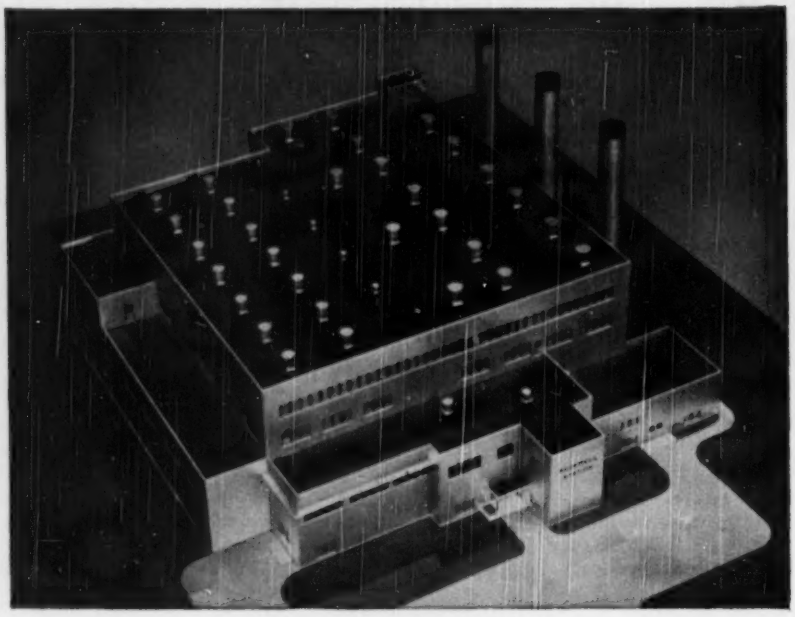
The broad range of Westinghouse network equipment enables you to employ the type of network that best suits the foreseeable demands. For instance, the light-duty CM-88 protector has made possible the economical *overhead* form of this system for areas where an underground system cannot be justified. It, together with the CM-44 and CM-22 protectors and associated Westinghouse network transformers, economically meets the requirements of all secondary network systems.

Booklet B-4002, "A-C Secondary Network Systems", contains complete information. And remember . . . our complete facilities, engineers and calculating boards are available to help you with your network planning. Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-97143

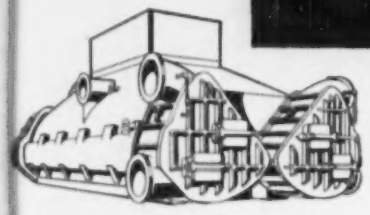


NEW PHILIPPINE STATION
to install two I-R condensers



A model of the new Rockwell Station which was designed as a low building to withstand earthquakes and high wind velocities. The Ingersoll-Rand low headroom "Twin" condenser was ideal for this low type of building.

The building is completely covered with aluminum, backed by a layer of glass wool and flat steel plate which is welded to the girts.



Ingersoll-Rand "Twin" condensers have given many new power plants the advantage of unusual economy in space and foundation requirements. Installation costs are further reduced because "Twin" condensers can be tubed in the shop, and each half can be shipped completely assembled.

Other Ingersoll-Rand equipment for the station:

Boiler-feed pumps
Circulating water pumps
Condensate pumps
Miscellaneous plant service pumps

Manila Electric Company's new 50,000-Kw power station will be served by two complete I-R Condensing Plants

Rehabilitation and expansion of the power generating facilities of the Manila Electric Co. has already reached the point where 98% more power is being furnished than before the war. War damaged equipment is being repaired; a 30,000-kw floating power plant has been leased from the U. S. Government and a new 50,000-kw power station, designed by Gilbert Associates, Inc., is being erected in the municipality of Makati.

Here there will be two 25,000-kw turbine-driven generators, each served by a *complete Ingersoll-Rand Condensing Plant*. Also, Ingersoll-Rand boiler-feed pumps will serve three oil-fired boilers, each with an evaporating capacity of 250,000 lb per hour at 850 psi, 910° F.

Manila Electric Co. has spared no effort to restore their electric service to more than pre-war standards and this selection of Ingersoll-Rand condensers and pumps will help insure the best in over-all plant operating economy.

When you expand your power-generation facilities, it will pay you to investigate the many new developments in Ingersoll-Rand equipment.

Compressors • Condensers
Turbo Blowers • Centrifugal Pumps
Rock Drills • Air Tools • Oil and Gas Engines

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

354-4

Service Restored

faster than ever after ice storm . . .

ICE storms are a utility's nightmare. Recently, the Missouri Public Service Corporation had a beauty on its hands. Driven by high velocity winds, heavy sleet lashed trees and roads, coated them with 6 to 8 inches of ice, pulled down hundreds of miles of line in the 17-county service area.

Thanks to *instant communication* made possible by General Electric 2-way radio in line trucks and supervisors' cars, service was restored at least 3 to 4 days earlier than would have been possible without the use of radio, according to officials at company headquarters in Warrensburg.

Utilities in every state use G-E 2-way radio to coordinate planned interruptions, to save manhours, truck hours, time on outages. Let our engineers study your communication problem, too—there's no obligation. Write: *General Electric Company, Section 2050, Electronics Park, Syracuse, New York.*

YOU BE THE JUDGE — CHECK THESE ADVANTAGES

Equipment Features	General Electric	Manufacturer A	Manufacturer B
Triple-Tuned Transformers (high selectivity with fewer tubes)	Yes	No	No
At Least 2 Watts Peak Audio Output	Yes	No	No
Instantaneous Modulation Limiting	Yes	Yes	No
Number of Tubes	18	26	22
Cost per Set of Tubes	$24.50	$50.16	$31.79
Spurious Radiation at any frequency	65 db	60 db in the band only	60 db
Cable Junction Box	Not Required	Required	Not Required
Key Lock for Protection of Every Unit	Yes	Optional at Extra Cost	Not Available
Microphone Quick Release Plug	Yes	Not Available	Not Available
20 kc & 40 kc Receiver Selectivity	Yes	No	No
Two-Unit Design for Maximum Mounting Flexibility	Yes	No	No

You can put your confidence in—

GENERAL ELECTRIC

3 WAYS TO MAKE SURE CABLES STAY PUT!

National Electrical Code paragraph 3014 specifies intervals at which cable supports must be used in vertical raceways.

When you're looking for a better way to hold cables fast, protect connections against pull or vibration—install O. Z. Cable Supports.

WHY?

BECAUSE O. Z. makes the *only* cable supports with one-piece impregnated maple plugs, machined to the exact wire size.

BECAUSE there is an O.Z. support for installation before or after pulling wire.

BECAUSE the serrated O. Z. liner provides a *positive* grip when plug is wedged home.

BECAUSE you can choose from three basic types the *best* support for your job—

1. **CONDUIT TYPE** for fast, easy installation on vertical runs. Screws directly on conduit. Malleable iron body grooved for tightening with screwdriver.
2. **LOCK TYPE** for use in *any* position. Threaded collar pressing against plug assures vibration-proof support under all conditions.
3. **SPLIT TYPE** for quick changeover jobs where cable is already installed. Body halves placed around cable, steel band fastened, and assembly placed on top of conduit.

There are thousands of O. Z. products designed to help you put power where you want it, and your O. Z. distributor is the man to see about them. Send for illustrated catalog.

And Remember—They're O. K. If They're O. Z.

CONDUIT FITTINGS • CABLE TERMINATORS • CAST IRON BOXES
GROUNDING DEVICES • SOLDERLESS CONNECTORS • POWER CONNECTORS

O.Z. ELECTRICAL MANUFACTURING COMPANY, INC.
262 BOND STREET BROOKLYN 2, N. Y.

This industry employee tests circuit of an ElectroniK Potentiometer.

Practical theory of fundamentals is given in Brown Training School lectures.

Benchwork is important to demonstrate practical application of this theory.

Your Dollars Buy More Than Just Instruments Here!

BROWN GIVES YOU THESE VALUES AT NO EXTRA COST!

Personnel Training • Practical Recommendations by Specialized Engineers • Nationwide Service

BROWN offers more than *instruments* alone. Brown offers *instrumentation.*

The difference is fundamental . . . for instrumentation starts *before* and continues *after* the sale of any one instrument.

First, to train your personnel for competent maintenance, Honeywell conducts the Brown Training School in Philadelphia, offering complete courses—tuition free.

Secondly, your local Honeywell Engineer* is fully qualified to discuss possible instrumentation applications in your plant . . . and, when necessary, to call upon industry-specialized groups of Honeywell engineers for practical recommendations.

Finally, the nationwide Honeywell Service Organization is available for either periodic or emergency instrument service.

Thus Brown helps maintain the efficiency of your operations . . . through a creative approach to instrumentation.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* 4568 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world. *Write for special booklet on* "The Brown Training School."

COMMERCIAL • RESIDENTIAL • INDUSTRIAL
WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

*He's as near as your phone. Call him today for further information. There's no obligation.

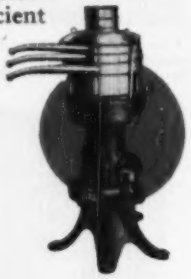
Honeywell
BROWN INSTRUMENTS

WHIRLING MILESTONES

De Laval today offers a centrifuge for every purification need in the power field. Back of every recommendation stands nearly three-quarters of a century of being *first* in major centrifugal developments.

1878 Carl Gustav De Laval invented the first continuous Cream Separator. He tried tubular bowl design.

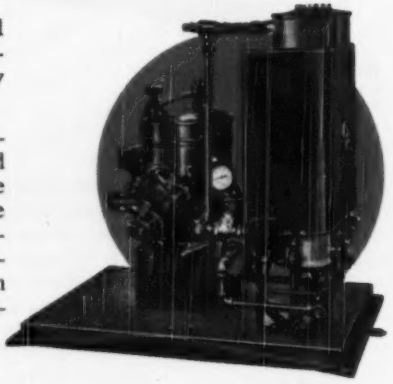
1890 Dr. De Laval abandoned tubular bowl, invented slower-speed disc bowl to stratify liquid for more efficient purification.



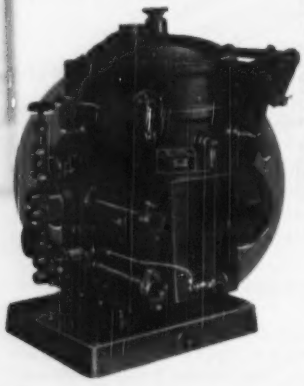
1918 First centrifugal Oil Purifier introduced by De Laval. This continuous Oil Purifier was driven by a small steam turbine.

1922 First De Laval centrifugal Insulating Oil Purifier installed. In 1950, the centrifuge is still the safest way to maintain insulating oil because water, once discharged, cannot recontaminate the dry oil.

1950 Full range of "Uni-Matic" Oil Purifiers now available, including No. 67 with a capacity of approximately 450 gph.



De Laval "Puri-Filter," combining centrifugal force and filtration, makes possible the removal of fly ash or moisture haze as well as more dangerous impurities. The "Puri-Filter" is the ultimate in turbine or engine oil lubrication purification.

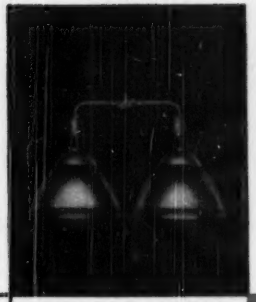


THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

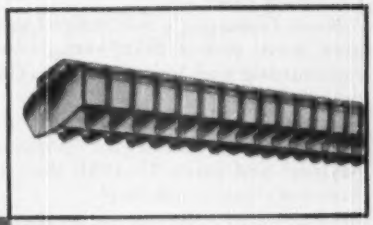
DE LAVAL OIL PURIFIERS

for most dependable power production

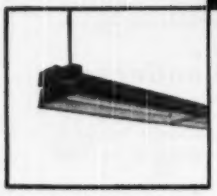
Light with confidence the proven miller way



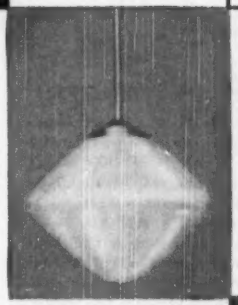
Mercury-Mazda for High-Bay areas



Series-Louver Fluorescent lighting



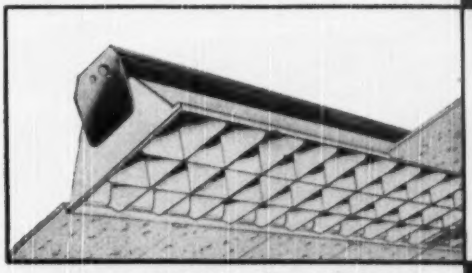
Industrial continuous fluorescent lighting



The Diamond Incandescent luminaire

Miller manufactures a complete line of lighting equipment for the best use of Fluorescent, Incandescent and Mercury lamps — one source of supply for all three types. Equipment built on a background of 106 years pioneering in Good Light, in rigid adherence to the Miller 8-Point standard of Quality construction. Lighting performance, long service, and low overall cost, make it the best investment of lighting dollars.

RLM Dome Reflector



*Fluorescent Troffer Lighting "*Ceilings Unlimited"*

THE miller COMPANY

*Reg. U. S. Pat. Off.

For power, for value, for every job
THEY'RE GREATER THAN EVER

Year after year the nation's truck users buy more Chevrolet trucks than any other make. For every kind of trucking job they prefer Chevrolet power and Chevrolet value.

Now, Chevrolet's two rugged valve-in-head engines give more power than ever. Advance design, solid construction and low prices give Chevrolet more value than ever.

Prove it to yourself. See the new Chevrolet P·L Trucks. Check them for popularity, performance, payload and price. In 1950 they are more than ever America's best truck buy!

CHEVROLET MOTOR DIVISION, *General Motors Corporation*, DETROIT 2, MICH.

LEADING WITH ALL THESE PLUS FEATURES:

• TWO GREAT VALVE-IN-HEAD ENGINES: the New 105-h.p. Load-Master and the Improved 92-h.p. Thrift-Master—to give you greater power per gallon, lower cost per load • THE NEW POWER-JET CARBURETOR: smoother, quicker acceleration response • DIAPHRAGM SPRING CLUTCH for easy action engagement • SYNCHRO-MESH TRANSMISSIONS for fast, smooth shifting • HYPOID REAR AXLES—5 times more durable than spiral bevel type • DOUBLE-ARTICULATED BRAKES—for complete driver control • WIDE-BASE WHEELS for increased tire mileage • ADVANCE-DESIGN STYLING with the "Cab that Breathes" • BALL-TYPE STEERING for easier handling • UNIT-DESIGN BODIES—precision built.

CHEVROLET

P*L*

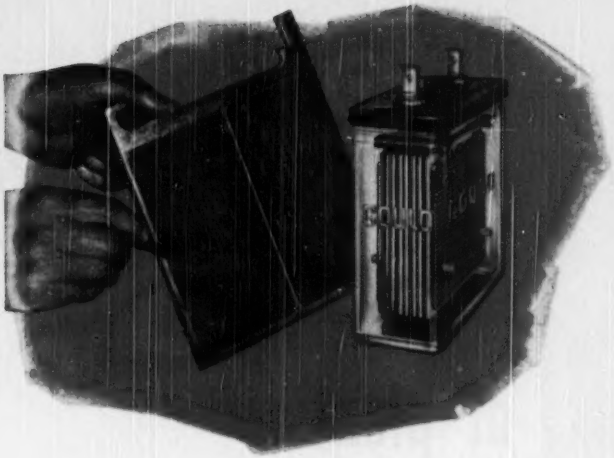
ADVANCE-DESIGN TRUCKS

P*opularity L*eaders
Chevrolet trucks outsell all others. In every postwar year truck users have bought more Chevrolets than any other make—proof of the owner satisfaction they have earned throughout the years.

P*erformance L*eaders
The new Chevrolet P·L trucks give you high pulling power over a wide range of usable road speeds—and on the straightaway, high acceleration to cut down total trip time.

P*ayload L*eaders The rugged construction and all-around economy of Chevrolet P·L trucks cut operating and repair costs—let you deliver the goods with real reductions in cost per ton per mile.

P*rice L*eaders From low selling price to high resale value, you're money ahead with Chevrolet trucks. Chevrolet's rock-bottom initial cost—outstandingly low cost of operation and upkeep—and high trade-in value, all add up to the lowest price for you.



MAINTENANCE:
"They never need service . . . and I add water only half as often."

ACCOUNTING:
"Per annum cost is lowest. We can amortize them over many more years."

ENGINEERING:
"They discharge at high rate, longer . . . float at same voltage all their life."

They All Prefer GOULD PLANTÉ

PURCHASING:
"You never replace a Planté. You just don't live that long!"

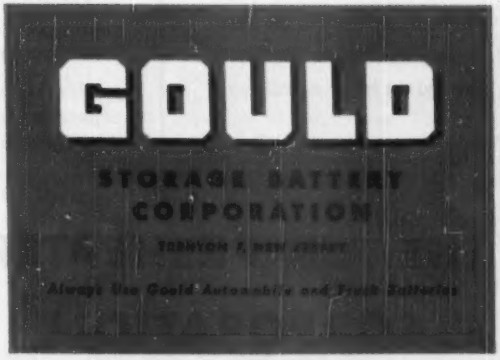
Gould Planté batteries practically last forever. Many are still in active full-float service after 20, 30, even 40 years!

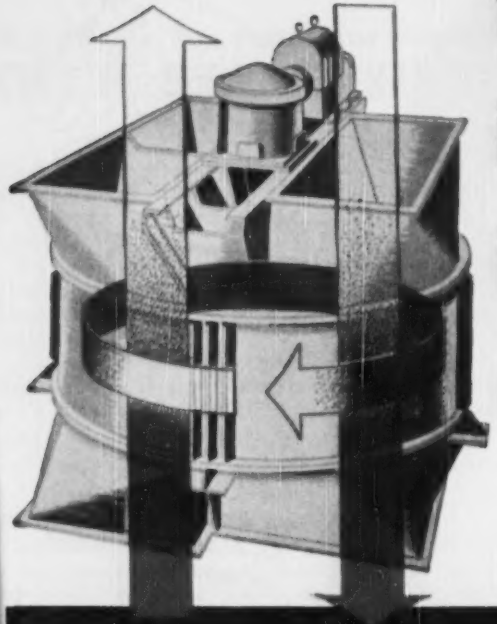
Planté plates are heavy, solid sheets of pure virgin lead. They contain *no* antimony. There is *no* migration of impurities from positive grids and grid frames to negative plates. Thus, Planté eliminates the primary cause of self-discharge, capacity losses and shortened battery life.

A huge reserve of pure lead continually replenishes spent active material. Voltage requirements and capacity remain constant throughout their long, low-cost life. These exclusive Gould features make

GOULD PLANTÉ

The Aristocrat of Stationary Batteries!





this preheater is cutting fuel costs in hundreds of plants

the *Ljungstrom* AIR PREHEATER

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

The Ljungstrom air preheater has proved its value in industrial and utility plants throughout the country. That is why every year a constantly increasing percentage of the installed boiler capacity is equipped with Ljungstrom air preheaters.

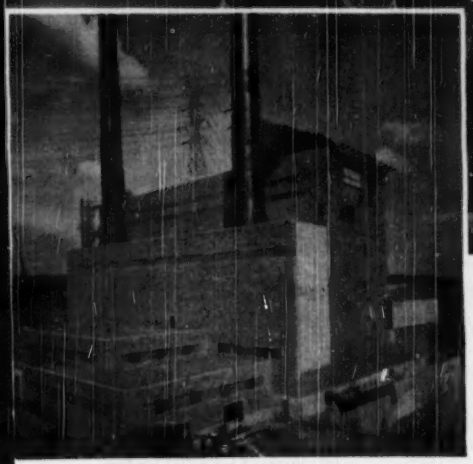
Your fuel costs will be lower too, when your boiler is equipped with the Ljungstrom air preheater. The regenerative design of the Ljungstrom permits reliable operation at low exit gas temperatures. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

If you are planning a new installation, or expanding your present one, our engineers will welcome the opportunity to show you how the Ljungstrom can raise the overall efficiency of *your* plant.

THE AIR PREHEATER
60 East 42nd Street, New York 17, N. Y.
CORPORATION

A new "high" in tower dependability and economy

These 240-ft. river crossing towers are among the highest in use. They're double circuit, 132 kv towers carrying six 477,000 CM, ACSR conductors and one 159,000 CM, ACSR ground wire.



American Bridge Company fabricated and erected the structural steelwork for the new Philip Sporn Plant, which utilizes four of the largest steam generators in the country.

"Streamlined" towers handle heavy duty job for A. G. E. System

THE tall, double-circuit towers shown above are among the approximately 160 erected to join the new 550,000-kw Philip Sporn Plant at Graham Station, W. Va., to the 132 kv transmission network of the American Gas and Electric System.

Designed and fabricated by American Bridge Company, these steel towers stand as proof of the soundness of "streamlined" towers—stripped of all non-essentials—for even the heaviest duty. Equipped with steel grillage earth anchors, they offer the added economies of simplified installation and frill-free construction that resists wind and wintry weather.

American Bridge has been designing, fabricating and erecting transmission towers for the nation's leading power companies for forty-five years. Its experience and facilities are second to none. Why not submit any questions you might have to our nearest Contracting Office? An inquiry involves no obligation.

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.

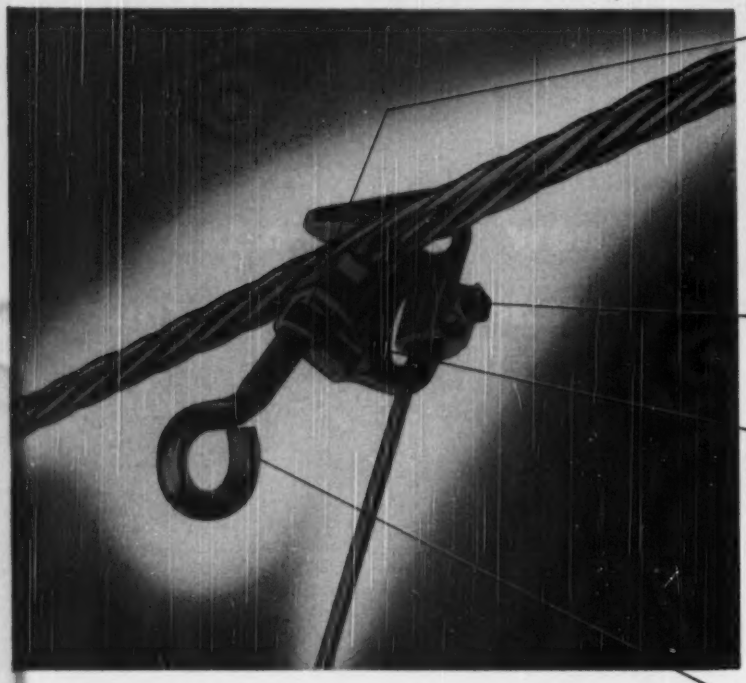
Contracting Offices in: AMBRIDGE · BALTIMORE · BOSTON · CHICAGO · CINCINNATI
CLEVELAND · DENVER · DETROIT · DULUTH · ELMIRA · GARY
MINNEAPOLIS · NEW YORK · PHILADELPHIA · PITTSBURGH
PORTLAND, ORE. · ST. LOUIS · SAN FRANCISCO · TRENTON
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

AMERICAN BRIDGE

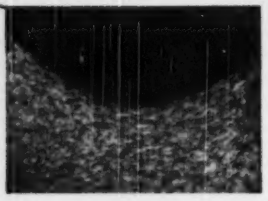
UNITED STATES STEEL

Accents on Accuracy

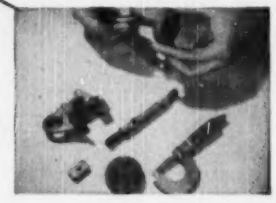


1. Accurate design provides components which align perfectly for drilling and tapping.

2. Special connector for tap wires is rugged, high conductivity copper extrusion. Silicon bronze screw insures good joint.



3. Compressed grain structure provides toughness, assures uniformity. (See photomicrograph above.)



4. Silicon bronze eye screw has precision rolled thread and accurately centered point for perfect cooperation with contact.

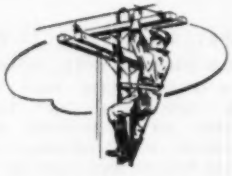
in the manufacture of the

NEW HOT LINE CLAMP

FOR A WIDE RANGE OF LINE AND TAP WIRES

Reliable's new hot line clamp for copper and Copperweld conductors is made of cold forged, work-hardened copper, for tough and uniform grain structure. This means strength to make a good joint — one that will develop and maintain plenty of pressure. It means *consistent* strength — to make every joint develop this pressure. Eye screw, tap screw, and pressure bar are silicon bronze. Tap wire connector is seamless copper extrusion. This new hot line clamp takes 4/0 strand to 6 solid line wire, and 3 #6 to 8 solid tap. Also supplied with electro-tin plate for use on steel and ACSR.

Available from stock. Investigate this new Reliable hot line clamp today.



POWER-LINE CONNECTORS
AND
CONSTRUCTION SPECIALTIES

Reliable ELECTRIC COMPANY

3145 CARROLL AVENUE, CHICAGO 12, ILLINOIS

OVER 40 YEARS OF SERVICE TO THE UTILITIES

POLE LINE CONSTRUCTION JOBS DESERVE THE VERY BEST

Actual photo of New Western Red Cedar Stocks in CONSOLIDATED Yards. Photo taken January 3, 1950.

Now . . you can get AMPLE STOCKS of

LIFE-SPAN *treated*

WESTERN RED CEDAR POLES

PROMPT DELIVERY from any CONSOLIDATED Supplier

Large quantities of nature's No. 1 poles, Western Red Cedar, are going through Consolidated Yards daily. There is an ample supply for the big construction jobs that lie ahead.

Nature builds *all* Western Red Cedar Poles on the same remarkable plan . . . same kinds of fibers, same lightness, straightness, durability and strength. There is none finer. Built by Nature . . . perfected by LIFE-SPAN! Submerged full length in first a hot, then a cold pentachlorophenol solution, Western Red Cedar and LIFE-SPAN make an incomparable combination. They are clean from end to end, safe and easy to handle.

LIFE-SPAN Poles mean dependable service up to pole line obsolescence. They're always clean and dry; they offer secure footing to linemen and build good public relations for the companies using them.

To be sure, to be doubly safe . . . specify LIFE-SPAN Western Red Cedar Poles.

The same LIFE-SPAN treatment is also available for Fir, Western Larch and Lodgepole Pine.

CONSOLIDATED TREATING CO.
MINNEAPOLIS, MINNESOTA

Life Span

Sold only by the following:

B. J. CARNEY & CO.
Spokane—Minneapolis

SCHAEFER-HITCHCOCK CO.
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Suppliers for Joslyn Mfg. & Supply Co.

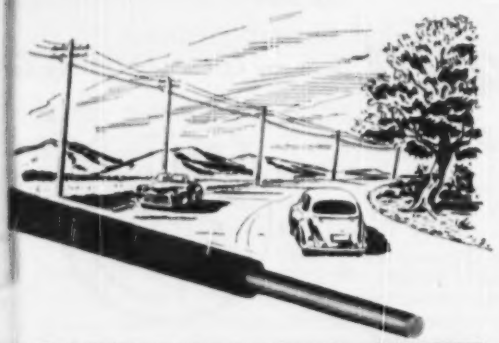
HAUGLE POLE & TIE CORP.
Chicago, Illinois

PAGE & HILL INC.
Minneapolis, Minnesota
50 Church Street, New York, N. Y.

The most dependable cable you can install has a jacket of NEOPRENE

When you've finished installing neoprene-jacketed cable, you can be confident that it's on the job to stay.

For the durability of properly compounded neoprene gives you that assurance no matter where it's used . . . overhead or underground . . . in rural or industrial areas. On weatherproof wire, barn wire, aerial and underground cable and many other constructions, a tough, durable neoprene jacket means longer cable life, contributes to important savings in replacement and maintenance costs.

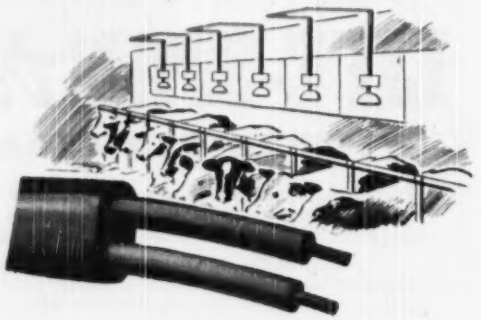


WEATHERPROOF WIRE

withstands weathering and aging . . . will not festoon

Even in areas where conditions are most destructive, this weatherproof wire covered with neoprene will not rot and festoon.

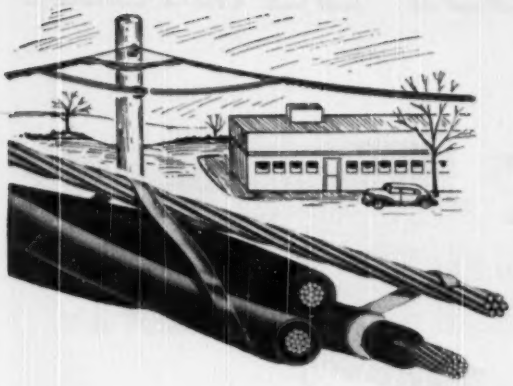
Neoprene resists the smoke and chemical vapors of industrial districts. It's not damaged by intense sunlight and salt spray in coastal regions. And because the special neoprene compound is utilized as the outer covering, there's no braid to disintegrate. The wire is clean to handle and light in weight.



BARN WIRE

resists rotting, fungus and flame— is easy to install

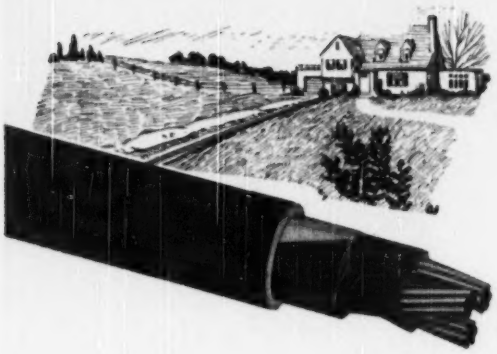
Cable engineers solved the problem of early deterioration of non-metallic sheathed cable in farm buildings by developing this new neoprene-jacketed barn wire. The neoprene jacket and insulation protect the cable against attack from moisture, fungus, rot and ammonia-laden air usually present in barns, stables and other farm utility structures. What's more, neoprene is flame-retarding. And its resistance to abrasion protects cable from cutting and scraping during and after installation.



AERIAL CABLE

withstands sunlight, ozone, weather, moisture, chemicals and heat

For all-round protection of this self-supporting aerial cable, the manufacturers equip it with a jacket of Du Pont neoprene. The neoprene withstands sunlight, weather, ozone, heat and cold . . . resists chemical vapors, oils and grease. It stands up under abrasion from trees and rough surfaces. The smooth neoprene jacket eliminates damage caused by static discharge and it's highly resistant to aging.



UNDERGROUND CABLE

resists corrosion, rot, vibration, crushing, oils and greases

When electric cable goes underground, it's protected by a jacket of the same tough, durable neoprene that withstands weather so well on overhead installations. For below the earth's surface, resilient neoprene acts as a protective armor against crushing and denting by settling earth . . . absorbs vibration shocks. It is undamaged by acid or alkaline soil; resists the deteriorating effects of galvanic action. And, in addition, the neoprene jacket resists abrasion during installation.

Do you have a problem involving wire and cable?

You can probably find the answer in one of the many available types covered with Du Pont neoprene. Neoprene's outstanding combination of excellent properties offers the kind of protection needed most for all kinds of wire and cable. It assures a tough armor that's little affected by conditions that cause most failures.

Du Pont manufactures neoprene in crude form only, and does not make finished neoprene products. But we'll be glad to help you with your problems and find you an adequate source of supply for neoprene-jacketed wire and cable. Write to E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division G-5, Wilmington 98, Delaware.

FREE!

THE NEOPRENE NOTEBOOK

Interesting stories . . . new, unusual applications of neoprene. Write E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Div. G-5, Wilmington 98, Delaware.

Tune in "Cavalcade of America" Tuesday Nights—NBC coast to coast

NEOPRENE

DU PONT

Because IT *MUST* BE RIGHT

You can count on

TRIANGLE

You can see for yourself that it takes massive machines to turn out lead covered and high voltage cables to meet today's rigid specifications. But machines alone cannot do the job: behind them must be men of many years' experience in making cable — in making it *right*.

At Triangle's efficient New Brunswick plant you will find modern machines manned by true craftsmen, checked by rigorous inspection, backed by unceasing development and research. To you, this means the finest in parkway...power...varnished cambric ...lead covered cables that can be constructed — today's top value in wire and cable.

Whether your needs are for standard cables built to I.P.C.E.A. recommendations, or for special cables tailor made to your own specifications, you will find Triangle engineers glad to consult with you.

TYPE RLJFJ

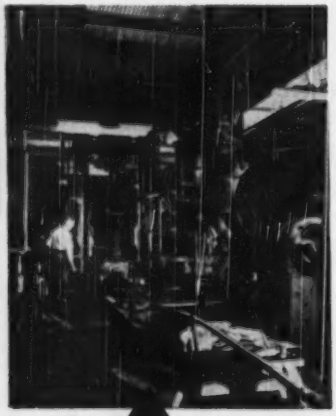
PARKWAY CABLE

TYPE VML

LEAD COVERED CABLE

TYPE V

VARNISHED CAMBRIC CABLE



Protection Plus—This huge press produces a smooth, uniform sheath of virgin lead for utmost cable protection.

The Trade Mark Of Top Value

TRIANGLE CONDUIT & CABLE CO., INC.

1900 JERSEY AVENUE • NEW BRUNSWICK, NEW JERSEY

IT *MUST* BE RIGHT!

Cables No. 500 Gives Full Details Of The Complete Triangle Line

"Glazon" & "Triasenal" Building Wire • "Triton" Control Wire • "Adaptal" General Purpose Wire • "Triex" Non-Metallic Sheathed Cable • "Trioprene" Trench Cable • Service Entrance, Parkway, Power & Varnished Cambric Cables • "Tristeel" Flexible, Thin Wall & Rigid Steel Conduit

A FIELD PROVED · PERFORMANCE RECORD

CORNELL-DUBILIER CAPACITORS

PRODUCED BY SPECIALISTS IN POWER-FACTOR CAPACITORS

Utilities throughout the world confirm the average of more than a decade of trouble-free service, in the field, delivered by C-D Capacitors. They've learned that C-D specialized experience pays off . . . that C-D Capacitors stand for Consistent Dependability. Your inquiries are invited. Cornell-Dubilier Electric Corporation, Dept. D50, South Plainfield, New Jersey. Other plants in New Bedford, Worcester and Brookline, Mass.; Providence, Rhode Island; Indianapolis, Indiana and Cleveland, Ohio.

A western utility application of C-D capacitors to help meet emergency power demands, the result of unusual load growth.

Follow the leaders

Demand dependable C-D Capacitors—built by capacitor specialists.

C-D Best by Field Test!

CORNELL-DUBILIER WORLD'S LARGEST MANUFACTURER OF CAPACITORS

Check American 4460

THE NEW FEATURES IN

GENERAL SERVICE BODY

SEALED, WEATHERTIGHT DOORS (Dust and Waterproof)

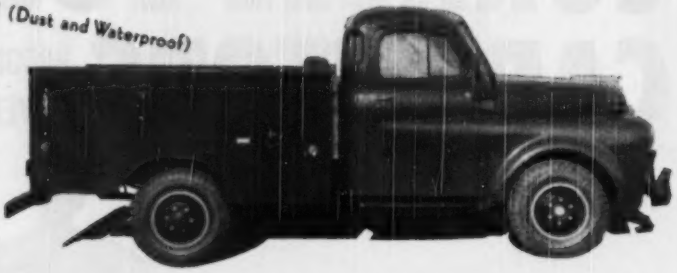
REMOVABLE FENDER PANELS

WIDER COMPARTMENTS

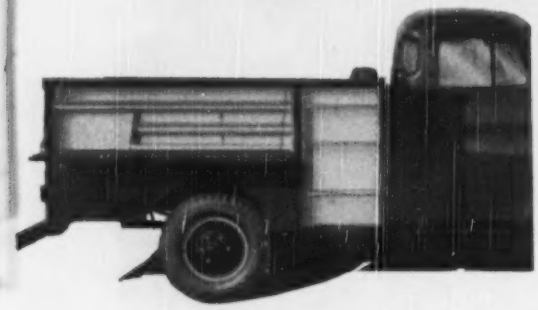
DEEPER BINS

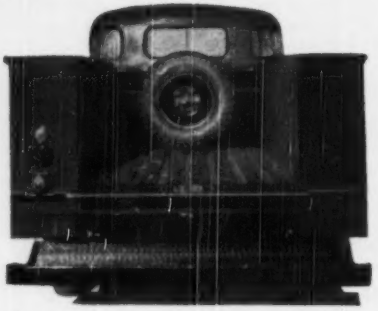
RECESSED HANDLES

MASTER KEYED



Each of these features has specific advantages to you. Wider compartments and deeper bins mean more space for tools and equipment—greater job capacity; the weathertight doors eliminate danger of rust or damage from the elements; the removable fender panels make wheel assemblies readily accessible and save replacement of entire side of body in event of damage. Recessed door handles prevent snagging. . . . The American 4460 General Service Body is ideal for general service, meter work, appliance sales and service, also general repair work. Ready for shipment, painted to your specifications, in three body lengths . . . 75", 90" and 104". Write us or ask your American Coach and Body salesman about the new features of the American General Service Body.





(Left) Note the spacious side boxes. The right horizontal compartment has two rows of 4" center adjustable bins. In vertical compartments on both sides, the three trays can be adjusted to any arrangement required. The flat, inner surface of the open horizontal doors serves as a handy work bench. All doors can be opened and closed with one hand, without removing gloves. (Right) Tailgate, in lowered position, is flush with floor for added space. Stops on each end hold tailgate rigidly in position.

THE American COACH & BODY COMPANY

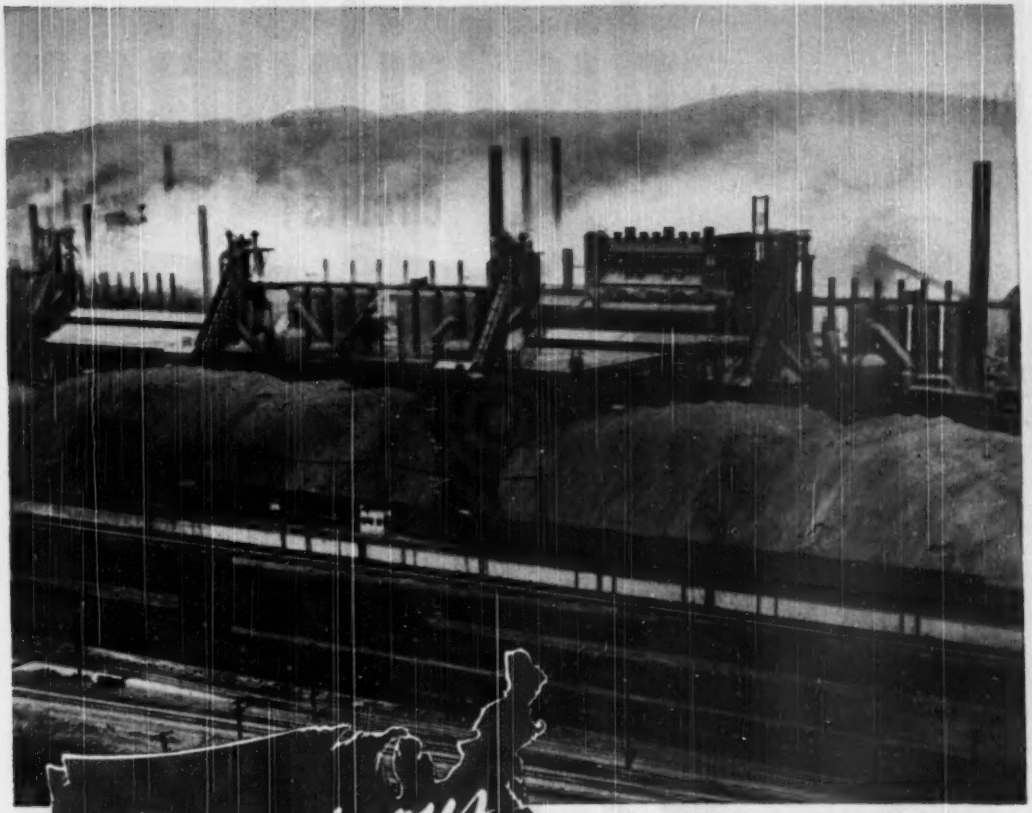
MAIN OFFICE AND PLANT — 9503 WOODLAND AVE., CLEVELAND 4, OHIO
CALIFORNIA DIVISION — 432 FIFTH STREET, OAKLAND 7, CALIFORNIA

SALES OFFICES: DES MOINES, IA. MONROE, N. Y. ATLANTA, GA. CHICAGO, ILL.

DISTRIBUTORS:

BAKER EQUIPMENT ENGINEERING CO. RICHMOND, VA.
EQUIPMENT SERVICE, INC. HARTFORD, CONN.
THE AMERICAN EQUIPMENT & BODY CO. LOS ANGELES, CALIF.

ACB



Bituminous

is indispensable to the power of America

The bituminous coal industry
has the strength—the know-how—
to meet *any* challenge.

Only with indispensable bituminous
can the greatness of America be maintained.

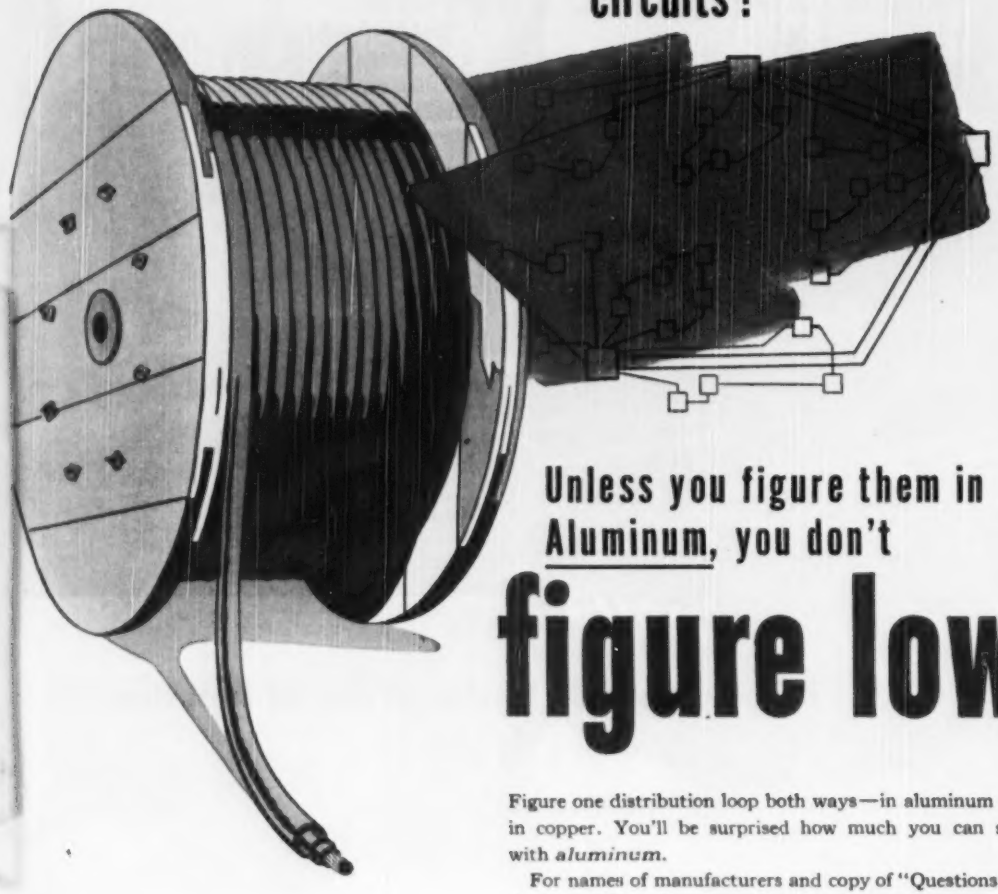
For excellent bituminous coals
to meet your every need,
Ask our man!

BALTIMORE & OHIO RAILROAD

Constantly *doing things*—**better!**

LINKING 13 GREAT STATES WITH THE NATION
B&O

Building insulated distribution circuits?



Unless you figure them in Aluminum, you don't figure low

Figure one distribution loop both ways—in aluminum and in copper. You'll be surprised how much you can save with *aluminum*.

For names of manufacturers and copy of "Questions and Answers About Aluminum Conductors", call your nearby Alcoa sales office, or write ALUMINUM COMPANY OF AMERICA, 1786E Gulf Building, Pittsburgh 19, Pennsylvania.

Insulated **Aluminum Conductors**

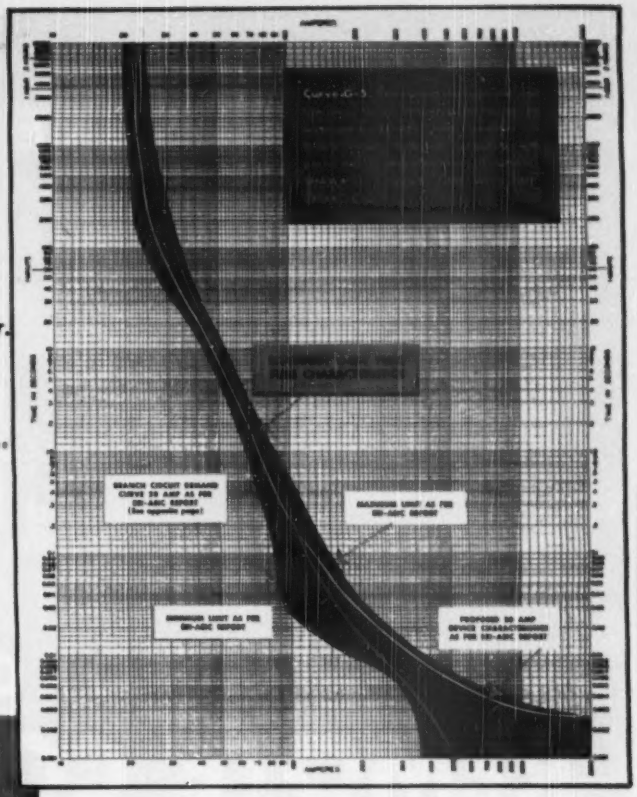
of ALCOA ALUMINUM are made by leading manufacturers

New C-Q-T Plug Fuse Gives

1. LONG TIME-DELAY...
enough to start a heavy washer.

2. SENSITIVITY...
enough to protect a cord.

HERE IT IS! See how the performance curve of the Shawmut C-QUICK FUSE WITH TIME-DELAY (C-Q-T) compares with the time-current characteristics for 20 ampere protective devices proposed by the EEI-AEIC Joint Committee on Branch Circuit Protection (Curve G5, page 30 of EEI-AEIC Report).



Shawmut C-Q-T Fuses, approved by Underwriters' Laboratories, Inc., come in the following ratings and color codes: 15 amp — blue; 20 amp — orange; 25 amp — red; 30 amp — green. Also in same ratings without color coding at slightly lower price.

Specify the NEW SHAWMUT C-QUICK PLUG FUSE WITH TIME-DELAY (C-Q-T)

A quick study of the above chart shows you that the Shawmut C-Q-T Fuse gives even better protection than the device proposed in the EEI-AEIC Report . . . *longer safe time-delay in the overload range . . . faster action in the short-circuit range.*

Designed for the average household branch circuit carrying a mixed load of appliances, it allows heavy-drawing appliances like washing machines to start and operate through their entire cycle. No needless fuse blowing . . . yet assures protection to lamp cords.

WRITE FOR FREE BULLETIN

For further details about Shawmut C-Q-T Fuses, write for bulletin. It gives you all the facts you should know about branch circuit overload protection. THE CHASE-SHAWMUT COMPANY, 373 Merrimac Street, Newburyport, Mass.

SINCE 1893

SHAWMUT Circuit-Matched FUSES
Insure More Accurately Engineered Protection For Any Circuit

SIMPLE

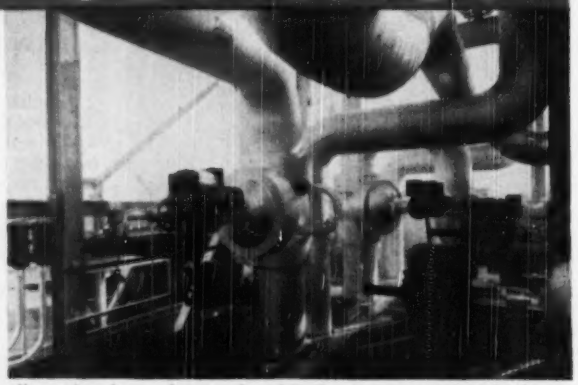
SURE

SAFE

LIMITORQUE REMOTE CONTROL

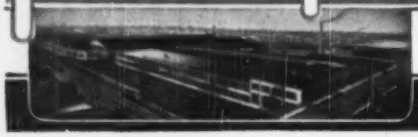
From coast to coast, indoors and out, thousands of LimiTorque Valve Controls are providing push-button operation of valves of all types in Central Stations, Industrial Power Plants, Hydro-Electric Plants and other Public Utilities. This operation may be either by remote or nearby control panels. LimiTorque prevents damage to stem, seat, disc, gate or plug, because the Torque Seating Switch limits the torque and shuts off the motor before trouble can occur. Actuation may be by any available power source: electricity, water, air, steam, gas or oil. LimiTorque may be supplied by your valve manufacturer.

Write for a copy of the LimiTorque Catalog. Please use your Business Letterhead.



Upper view shows a large number of LimiTorques in one station of a large eastern public utility company. Lower photo pictures a few of many LimiTorques at a large California electric plant. Many more are installed in other plants of this company.

Philadelphia Gear Works, INC.



ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

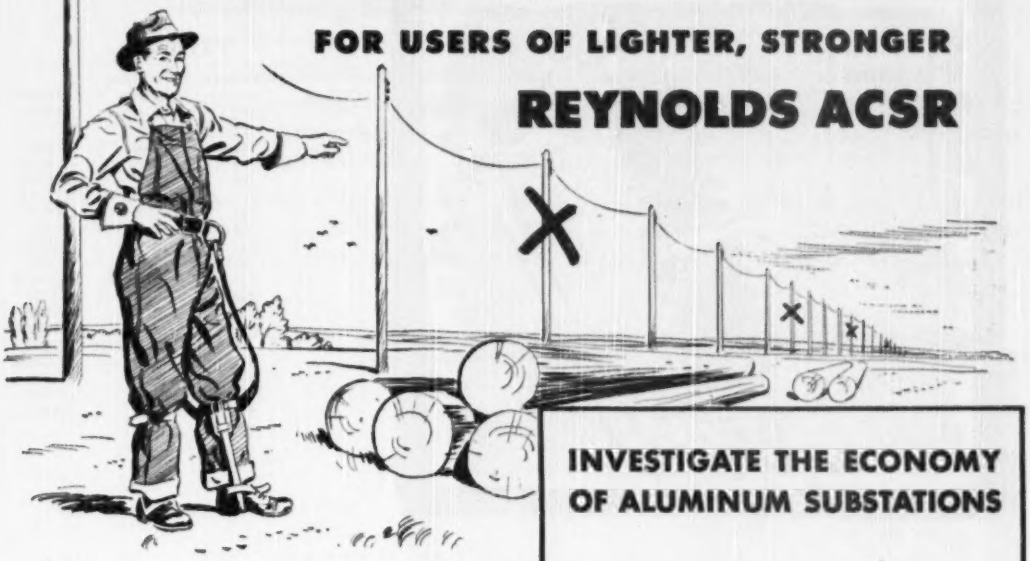
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Pole Taxes Slashed

FOR USERS OF LIGHTER, STRONGER REYNOLDS ACSR



YOU'RE paying an extra pole tax every day you postpone using Reynolds ACSR. Here's why. Reports from the field show savings up to 4 poles per mile with ACSR. The reason — this high strength yet lightweight aluminum conductor permits greater spans without increase in sag.

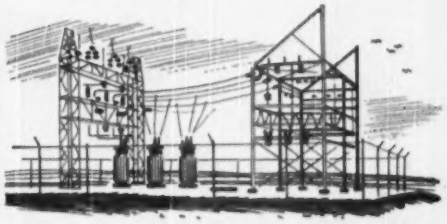
And that's just a starter. Initial cost of Reynolds ACSR is considerably lower than copper. Faster handling and stringing because of this conductor's light weight means further economies in the field.

Reynolds cable facilities assure highest quality of product and on-the-dot deliveries. For prices and product data, call the Reynolds office listed under "Aluminum" in your classified telephone directory.

ACSR MANUAL FOR ENGINEERS

Contains helpful information, complete charts and tables. Free when requested on business letterhead . . . write to Reynolds Metals Company, Louisville 1, Kentucky.

INVESTIGATE THE ECONOMY OF ALUMINUM SUBSTATIONS



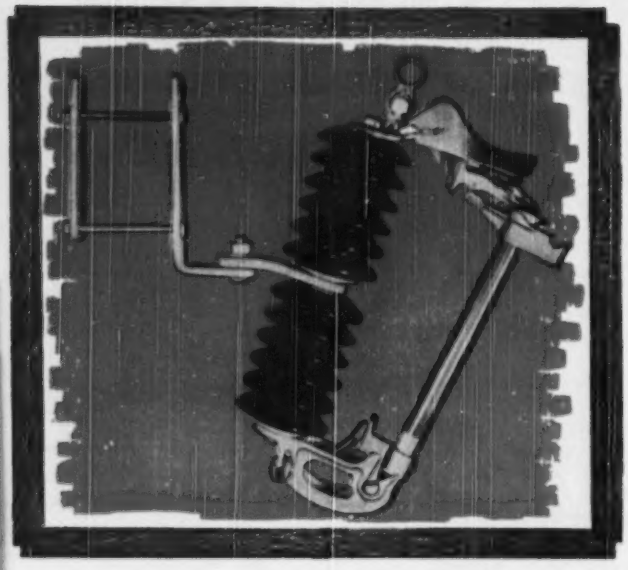
Substations made of aluminum structurals have proved their economy. Aluminum's light weight simplifies foundation problems; permits prefabrication of larger sections; speeds erection with minimum labor. Freedom from rust eliminates cost of painting and consequent off-power time.

REYNOLDS METALS

REYNOLDS *Lifetime* ALUMINUM

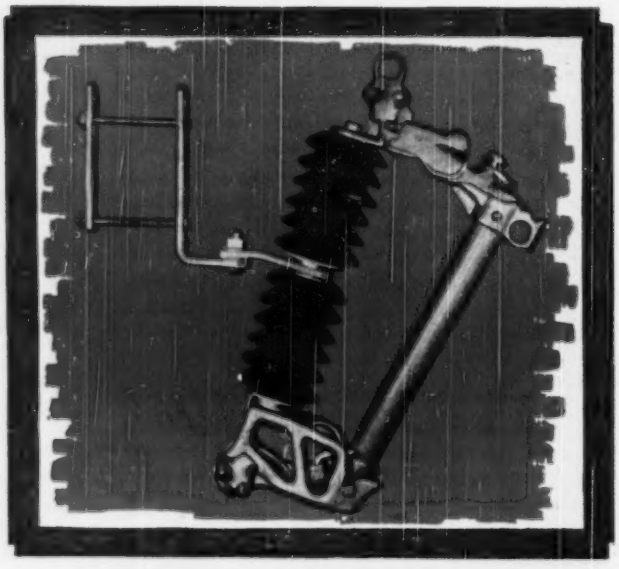
CONSIDER ALUMINUM • CONSULT REYNOLDS • THE COMPLETE ALUMINUM SERVICE

Mr. DISTRIBUTION



TYPE 33

Voltage (KV)	Continuous Current (Amp.)	Interrupting Capacity (RMS Amp.)	Catalogue Number
5	50	1200	373600
5	100	2000	373600-C
5	50	4000	373700-C
5	100	4000	373700-C
5	200	4000	373710
7.5	50	1200	373601
	100	2000	373601-C
	50	4000	373701
	100	4000	373701-C
	200	4000	373711
15	50	1200	373602
	100	2000	373602-C
	50	4000	373702
	100	4000	373702-C
	200	4000	373712
23	50	1200	373603
	100	2000	373603-C



TYPE H-33-D

Voltage (KV)	Continuous Current (Amp.)	Interrupting Capacity (RMS Amp.)	Catalogue Number
5	50	9000	H-33-D 5050
	100	13000	H-33-D 50100
	200	17000	H-33-D 50200
7.5	50	7000	H-33-D 7550
	100	10000	H-33-D 75100
	200	14000	H-33-D 75200
15	50	6000	H-33-D 1550
	100	9000	H-33-D 15100
	200	11000	H-33-D 15200

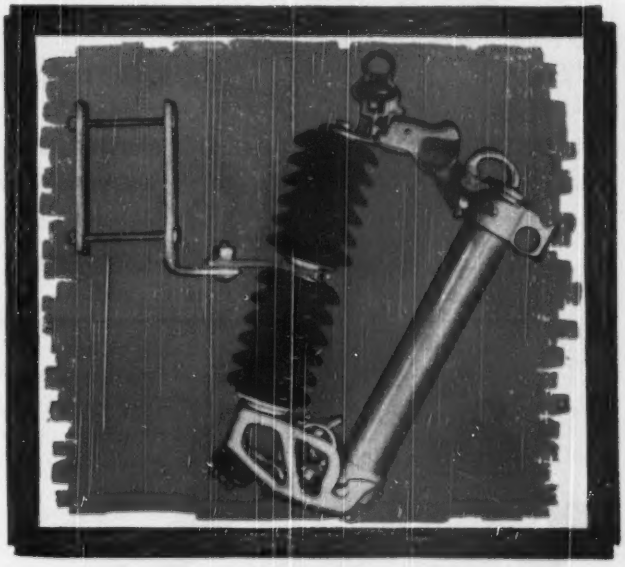
THE MOST COMPLETE LINE OF OPEN TYPE DROPOUT EXPULSION CUTOUTS AVAILABLE TO THE INDUSTRY

ENGINEER:

The entire electrical industry is increasingly faced with cutout application problems resulting from wide variations in fault capacities and loads on distribution circuits.

Southern States early recognized this problem and developed three classes of distribution cutouts each designed to cover a particular range of current carrying and fault interrupting capacities. SS cutouts are available in continuous current ratings as high as 300 amp. with fault current capacities above 500,000 KVA.

The cutouts illustrated incorporate improvements of SS cutouts which have been giving dependable service to many users for two decades. Tables below show specific ratings in which SS open type dropout cutouts are available.



TYPE HH-33-D

Voltage (KV)	Continuous Current (Amp.)	Interrupting Capacity (RMS Amp.)	Catalogue Number
5	50	10000	HH-33-D 5050
	100	16000	HH-33-D 50100
	200	20000	HH-33-D 50200
	300	25000	HH-33-D 50300
7.5	50	9000	HH-33-D 7550
	100	14000	HH-33-D 75100
	200	19000	HH-33-D 75200
	300	23000	HH-33-D 75300
15	50	8000	HH-33-D 1550
	100	12000	HH-33-D 15100
	200	16000	HH-33-D 15200
	300	20000	HH-33-D 15300

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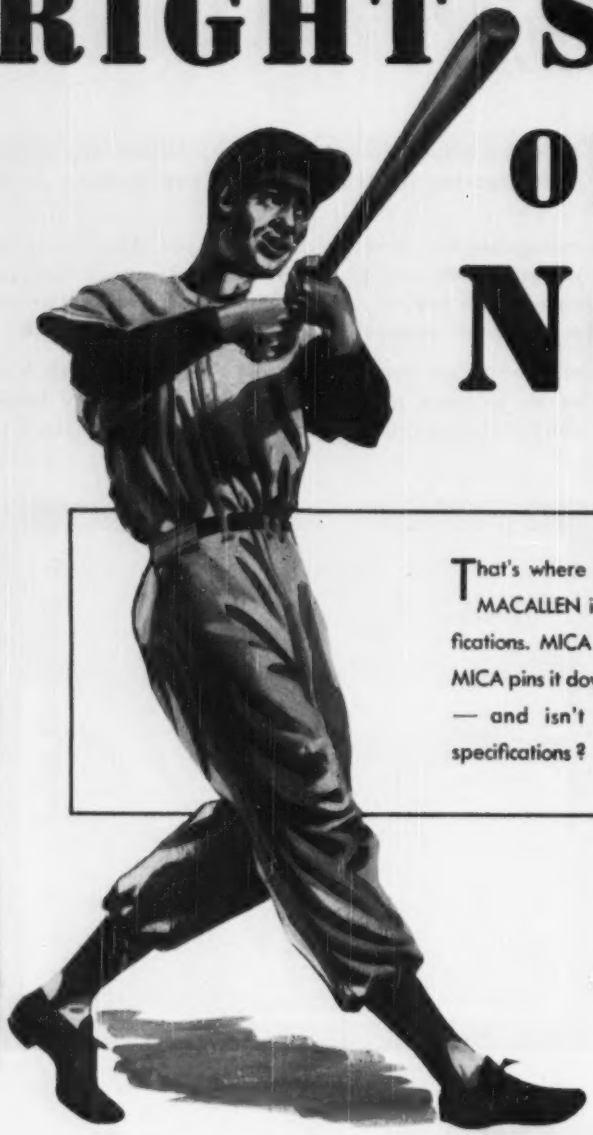

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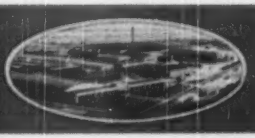

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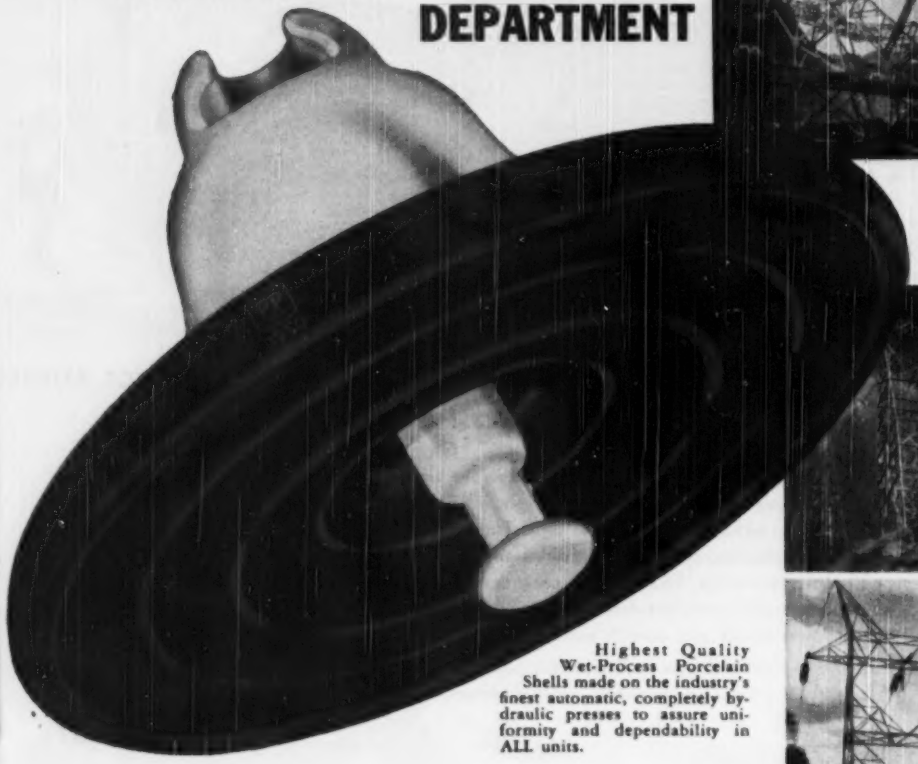

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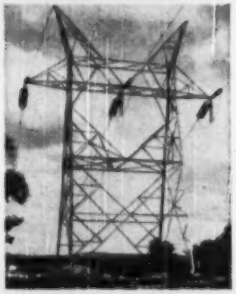

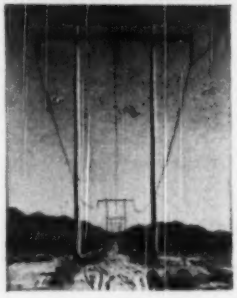

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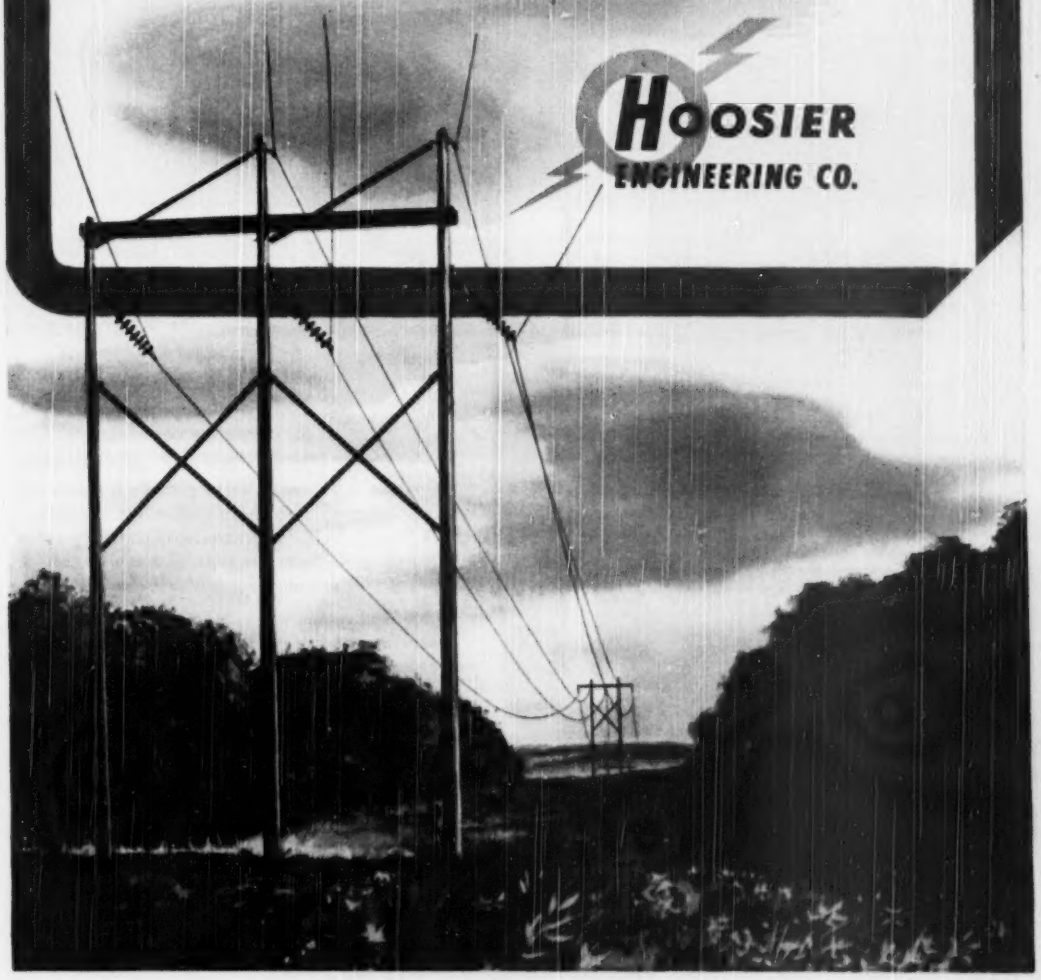

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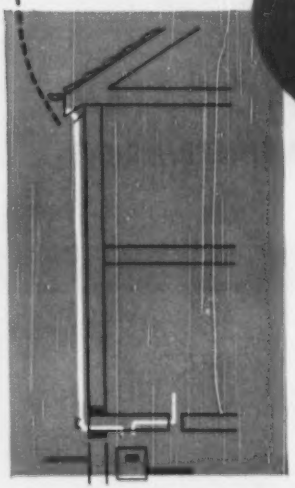

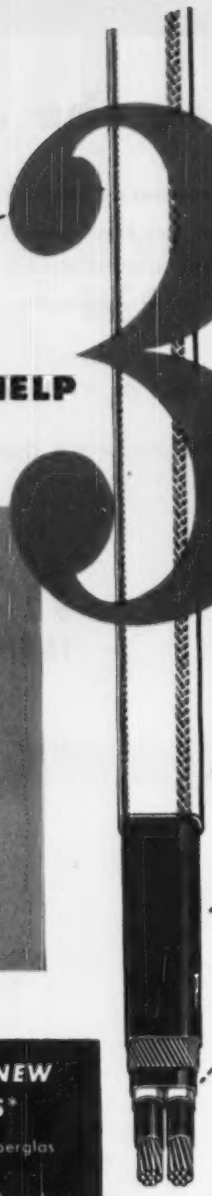

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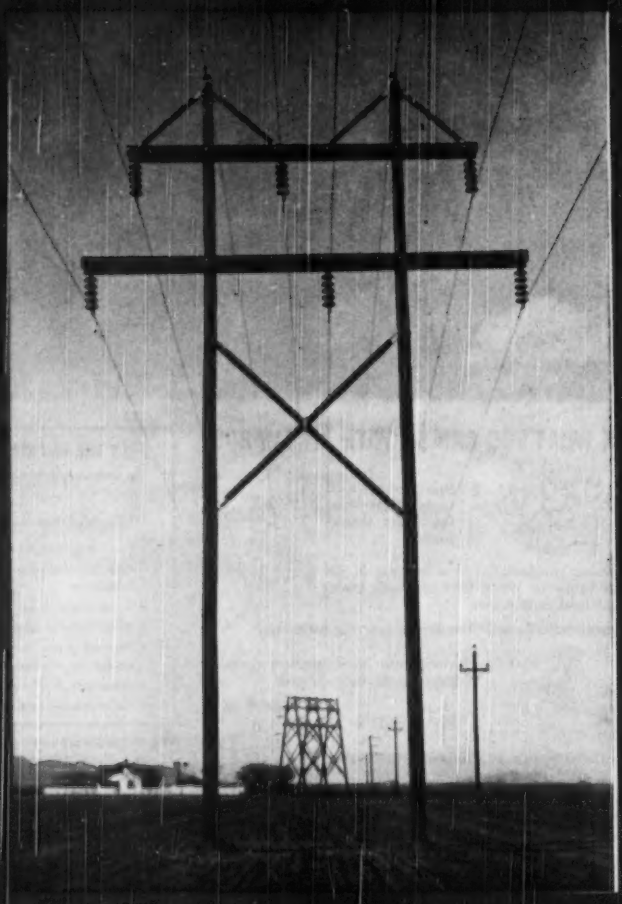

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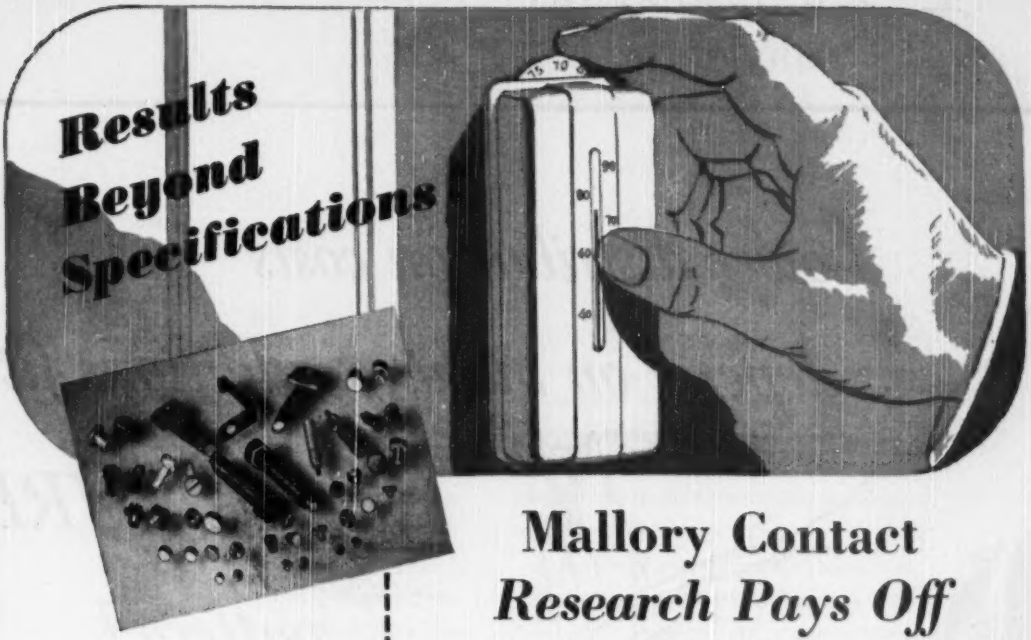

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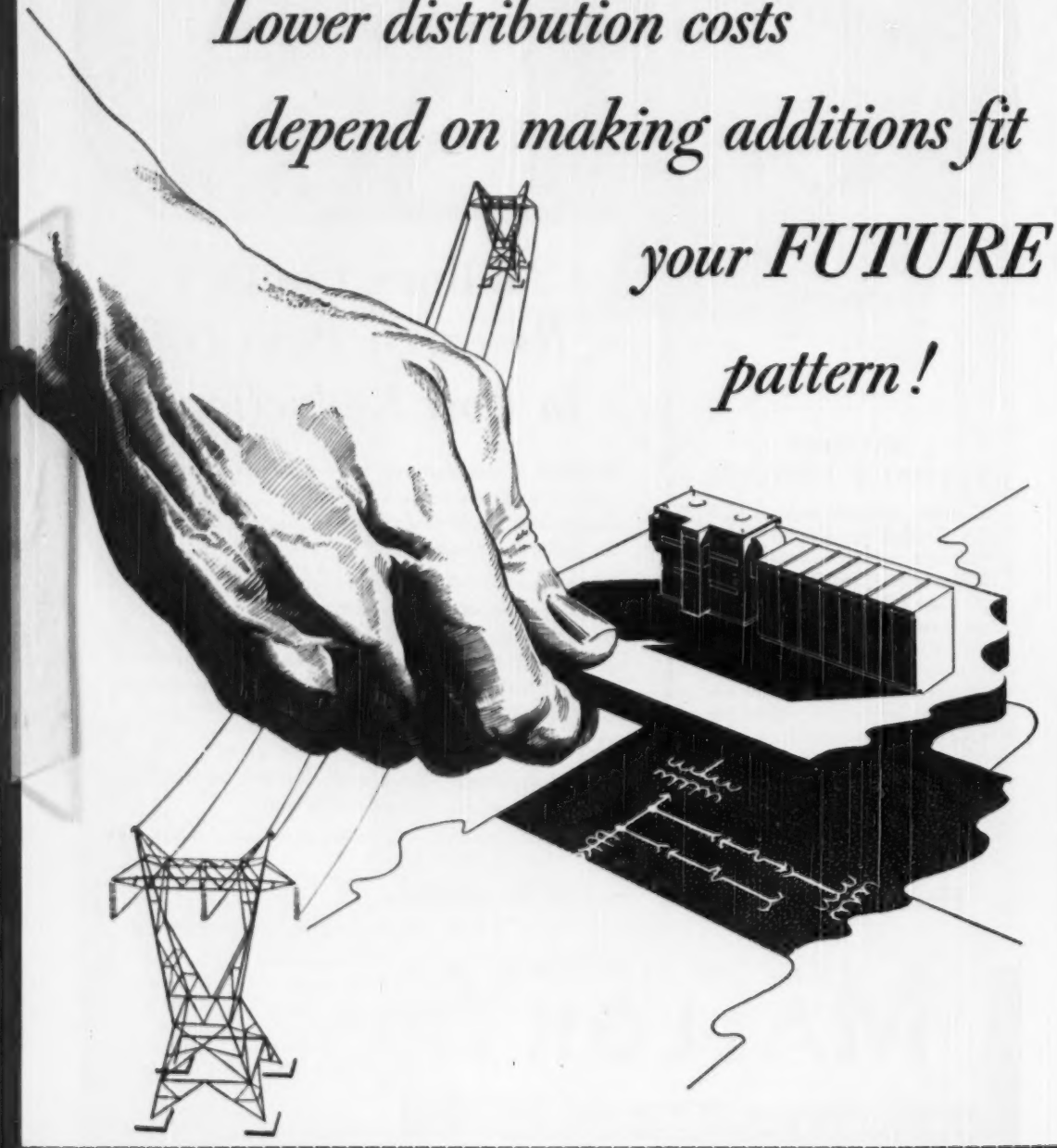

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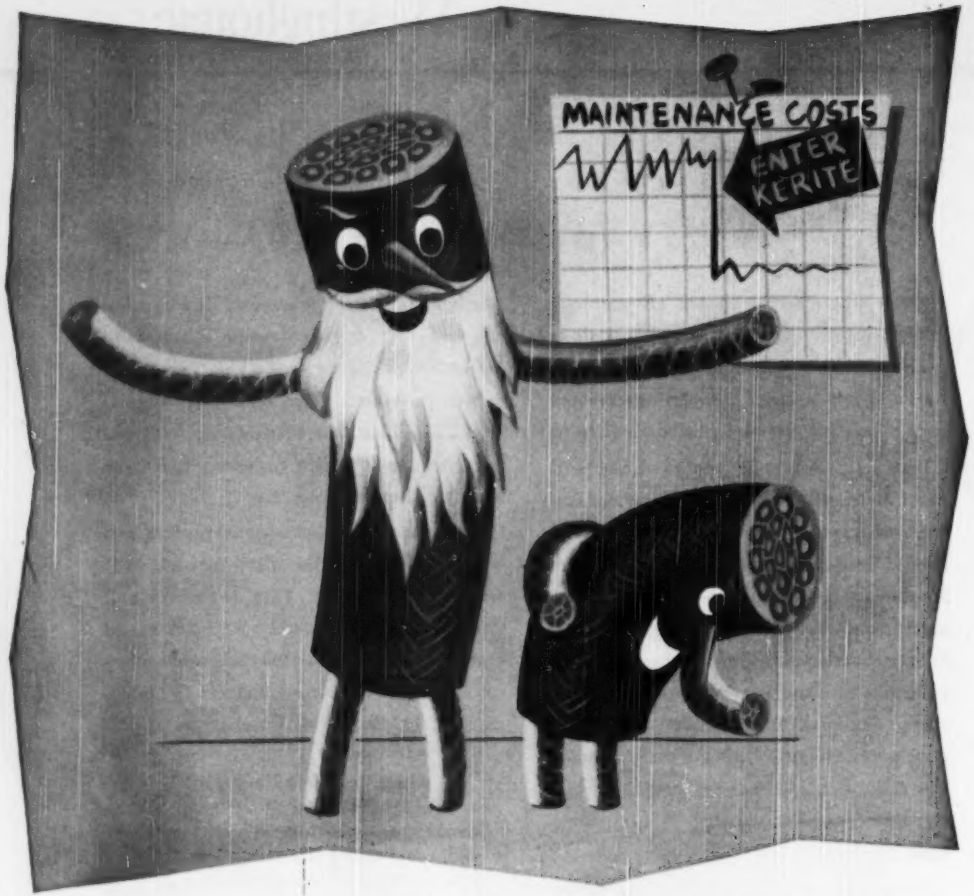

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Facing The Future

THE ELECTRICAL INDUSTRY looks back upon the last few years with pride. For, in spite of many tough postwar problems, an outstanding record has been made both in the rendering of service and in the related fields of technological improvement, employee and community relations and finance.

The source of confidence in the future is normally the record of creditable performance in the past. But, in the present political climate, the power companies find consolation from this source barren. They must find another. This can only be astute planning in advance along with the will to follow through on plans thus made. Only in this way can the industry acquire confidence, find assurance that it is adequately prepared for what the future holds. This will require frequent, searching re-examination and re-appraisal of all phases of the political, social, financial, and technical problems that face the industry.

Leading in importance we would place the matter of governmental sponsorship of public power. It must also be assumed that the federal studies of the water supply, power sites, and fuel supplies of the country are not a passing fancy of the present administration. They are part of a trend toward integration of the natural resources of this country. The power companies must be represented in these activities to protect their own interests and must carry on their own investigations in a forthright manner.

In addition, the problems of supplying the tremendous power requirements of the future make it imperative constantly to study, individually and as an industry, the growth patterns, sources of fuel and other energy, locations for facilities, interconnections, continuity of supply, safety to the public, appearance of lines, cost of service, community development, manpower and the characteristics of the utilization equipment. All the technical, economic and financial talents of the utilities and manufacturers should be devoted to the task of planning for the power systems of the future in order to provide adequate service in peace and war, in town and country, in the home, industry, and commercial establishment.

With these ideas in mind, we have devoted this issue of ELECTRICAL WORLD to a forecast of political, economic, and industry trends. The economic developments and the related electrical industry expansion are far more important than the timing of the predicted amounts by five year periods. The choice of a 15-year projection was made to cover power loads double and triple those of today. Also we wished to stay within the life span and the active participation of management personnel now coming into top industry positions.

Whether the countrywide peak demands reach 167 million kw in 1965 and load factors drop to 52%, as we predict, or the peak be lower and the load factor higher may well depend more upon the enterprise of utility management than upon economic events.

The essentiality of discussion and analysis of probable future trends is the point upon which we wish to focus the industry's attention. If this presentation provides some stimulus to management's interest in long-range planning and confirms the employees' confidence in the future of this great industry, our objective will be reached.

Change the Truman "Deal"

IF THERE was any doubt in the minds of the electric utility industry's leadership—and apparently there was—as to Harry Truman's views on public power, they should have been dispelled by now. The President's speech at Grand Coulee Dam made it plain that he still favored more public power in the form of hydro electric projects, new valley authorities and public utility districts. He was very specific about it.

He was also frank about his lack of sympathy for the protests of investor-owned companies against federal and local governmental encroachment.

"This opposition of the private power companies is wrong," he asserted. "It would deny the people the benefits of low-cost power they themselves have brought about through public investment."

The point of this and similar irresponsible statements is that the President, whatever his motives, has committed all the vast influence of his office to the public side of the public-private power scrap. He has committed his Administration to all the legal inequities enforced upon the industry by government in the past and to "continue to fight" for more of the same.

Any notions that the President might change his views on power, either generally or in individual cases, must be abandoned. Since his re-election campaign two years ago, when he first embraced the federal power program of his predecessor, he simply has expanded his endorsement to include all phases of public power. It's high time the industry took full cognizance of the fact that public power, like the Brannan plan, soft labor legislation, and free spending, is an inseparable segment of Truman Fair Deal policy. The only way to change the policy is to change the "Deal."

Engineers Available

ELECTRICAL WORLD pointed out in an editorial in the April 10 issue, entitled "Shortage of Engineers Impends," that there will be too many engineering graduates for the economy to absorb in 1950, but by 1952 this situation will reverse. In accordance with the report of the American Society for Engineering Education, there will be a serious shortage between 1954 and 1965 unless freshman enrollments pick up considerably.

Now we have the report of the Engineers Joint Council showing that employment of engineering graduates in June of this year will be 30% below that of 1949. The council found that whereas 8 organizations in the electrical industry hired 1,514 engineering graduates in 1949, their quota for 1950 is only 1,057. From this bit of information it appears that during the years 1950, '51, and possibly '52 the electric utilities have a great opportunity to build up their engineering staffs for the great growth in the next decade.

Whereas the electric utilities have had to compete with industry in the past few years for the best engineering minds, today the utilities can take their choice. The starting wages should not be quite as high as in previous years thereby permitting wider latitude in training programs without prohibitive expense. It might be well for the personal managers to review again not only their requirements for 1950 but also their future needs at a time when there is a small surplus of engineers. Then when the shortage again faces the industry, the utilities will be well prepared to carry on with high caliber men secured in the early '50's.

Cost Control

IN HIS RECENT address before the Southeastern Electric Exchange, J. M. Barry, president of Alabama Power Co, paid a great compliment to the electrical manufacturers. He said:

"It would not be proper to close this discussion without acknowledging the great contribution of the manufacturers to the programs of cost control of the utility companies. With price indices generally about double what they were ten years ago, the electric companies have been able to meet the tremendous demands placed on their systems at plant costs within reason by using larger and more efficient generating units, boilers of capacities and characteristics undreamed of a few years ago, larger and improved transformers and circuit breakers, and numerous other products of advance design coming from the plants of the manufacturers. . . . I am sure that all electric companies gratefully acknowledge these contributions, so characteristic of our free enterprise system."

The statistical facts telling the story of the maintenance of consumer prices of electrical manufactured products are not immediately available. But it is common knowledge that increases have been held in the 10-to-30% range for most items. Barry should be complimented for emphasizing this great contribution of the electrical manufacturers at a time when low rates for electricity have such great economic and political significance. The purchasing policies and engineering specifications of the consumers of electrical equipment can contribute further to the maintenance of low prices. These and other elements in the price picture warrant attention by all others in the electrical industry. And in giving credit for this great contribution, those in authority should look ahead to means of even greater accomplishments in the future.

EEI's 18th Annual Convention

THE EDISON ELECTRIC INSTITUTE has planned an outstanding program for its 18th annual meeting, June 5-7, at Atlantic City. The imposing list of speakers and subjects would be difficult indeed to surpass. C. E. Kohlhepp as chairman and the other members of the committee are to be congratulated.

The Electrical Week

A new program to inform workers on the principles of the American economic system has been developed by Edwin Vennard and Robb M. Winsborough of Middle West Service Co. Best of all, before-and-after surveys show that it works; 11 electric companies are now using it (p 90) . . . The SPA "contract" with two Oklahoma utilities has been killed by Interior Secretary Chapman. He informed a Senate subcommittee that it "would be contrary to federal public power policy." He might consider a less comprehensive agreement (p 92) . . . At its annual meeting the Public Utilities Advertising Association stuck close to the techniques of the advertising profession, but results of the Better Copy Contest indicate which companies are doing an above-average job in indirect selling (p 93).

• • •

One of Southeastern Power Administration's first jobs will be a study of power requirements of its area. That's what Administrator Ben W. Creim told newsmen recently at his new Elberton, Ga., offices. The study will exclude the TVA area and, apparently, will ignore Federal Power Commission, NSRB, and industry surveys of the same type.

Beware of too much cheer at the excise tax cuts being written by the House Ways and Means Committee. Washington opinion now is that there may not be a tax bill. Congress probably will pass a bill calling for cuts but offering no method of making them up in new revenue. Truman, the guessing goes, will veto the bill, and Congress won't override it.

President Truman's Grand Coulee speech—his most frank call for federal and other public power and his most bitter attack on the industry—leaves one clear impression: The industry's only hope for political success in Washington during the next two years is by making marked gains in the Congressional elections this fall.

A prophet is not without honor, save in his own country and in his own house. "The Ten Little Free Workers" ad, (EW, Jan 16, p 46) written by Charles D. Lyon of Potomac Edison Co, failed to place in the Public Utilities Advertising Association Better Copy Contest. Lyon was secretary of the association. The ad has been reprinted in some form by nearly every investor-owned electric utility in the United States, by many trade organizations, and in a number of foreign countries.

President Truman May 10 signed the bill that creates a National Science Foundation. It came after a five-year fight by scientists, but the new agency to promote basic research looks to be pretty small potatoes. For the new fiscal year starting July 1, the foundation will have only half a million dollars and a top limit of $15 million for each year thereafter.

Amount of power made available by British Columbia Power Corp for the first quarter of 1950 increased 46% over a similar period in 1949. During March the firm's output increased 37% over output for March last year.

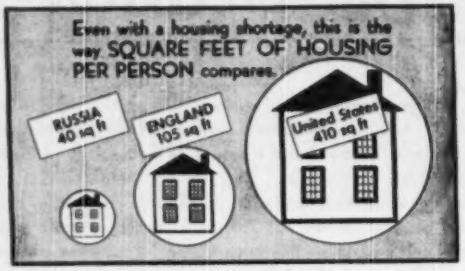
The President's technical conference on air pollution was held recently in Washington. Major conclusion reached by the 700 conferees: More research is needed on the problem.

Notes From The News

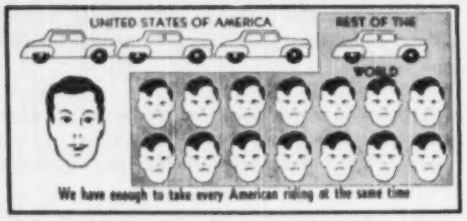
Consolidated Gas Electric Light & Power Co of Baltimore has filed suit to recover $73,496.52 of a $100,710 tax payment made in 1946. The firm contends ship-repair yards in the area are industrial and not commercial consumers and it should therefore not be required to pay tax on energy supplied to them . . . Hydro generation on the New England Electric System was off 9% from last year in the first quarter of 1950, but the outlook is improving. Total generation on the system in April ran 15% above a year ago . . . Concrete pouring schedule at Hungry Horse Dam has been stepped up. The goal is to increase placements from 2,500 cu yd daily to 3,300 . . . Consumption of electricity on the Nashville electric service system increased 21.79% in April over the same month last year . . . The Nova Scotia Power Commission reports 420 miles of new rural lines have been strung during the past year. It now serves 18,956 customers, an increase of 2,958 over a year ago. Output last year totaled 248,724,341 kwhr . . . Thomas W. Martin, chairman of Alabama Power Co, and Homer M. Pace, vice president, South Carolina Electric & Gas Co, have been named by the Southern Association of Science and Industry as two of three men who have made the most "significant contributions to the technological progress of the South" . . . Gordon Persons, chairman of the Alabama Public Service Commission, has won the Democratic nomination for governor in a race with 14 other candidates.

Benefits of the American System . . .

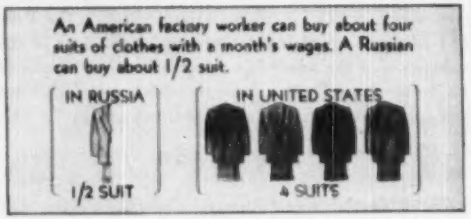
AMERICANS WORK willingly for economic gain in the form of profits and wages. In dictatorships men are forced to work


Even with a housing shortage, this is the way SQUARE FEET OF HOUSING PER PERSON compares.
RUSSIA 40 sq ft
ENGLAND 105 sq ft
United States 410 sq ft

THE FREE ENTERPRISE system has given workers in America better homes than workers anywhere else in the world enjoy



ALTHOUGH AMERICANS represent only 1/15 of the world's population, they own three cars to one for the rest of the world


An American factory worker can buy about four suits of clothes with a month's wages. A Russian can buy about 1/2 suit.
IN RUSSIA
1/2 SUIT
IN UNITED STATES
4 SUITS

AMERICANS are better clothed than people in other lands, another of the advantages of the American economic system

Selling Workers on Free Enterprise

Six-Hour Program Gives Employees Information about Basic Principles of the American Economic System; Results Show the Course Is a Success

A SIX-HOUR PROGRAM that successfully informs workers on the principles of the American economic system is now available to electric utilities. Developed by Edwin Vennard and Robb M. Winsborough of Middle West Service Co, the program is now being used by 11 electric companies. More than 9,000 utility workers are enrolled.

To show the effectiveness of the program, Vennard conducted an opinion poll of 256 supervisory and operating employees before and after taking the course. He found striking changes in their beliefs. Before taking the course only 33.3% of the operating group believed that better tools and machines had done most to improve living standards. Strong labor unions were given the credit by 61.2%. After the course 75.7% believed that better tools and machines were responsible, only 21.6% the unions.

After taking the course both supervisors and operators were 100% against government ownership of power companies. Previously 4.8% of the supervisors and 3.0% of the operators had favored it.

In all 20 questions were asked. The accompanying table gives a sampling of the change in opinions of the two groups on questions relating to profits, government regulation, and addition of new machinery.

The program stresses the great disparity between the high living standards in the United States and the lower ones prevailing elsewhere in the world. Major points covered include the five key principles of the American economic system: private property, free markets, profit and wage incentive, competition, and government regulation without ownership. It is pointed out that this system has resulted in longer life expectancy for Americans, reduction in infant mortality and the death rate from disease, the best diet and housing in the world, and more security in the form of life insurance.

Workers are briefed on how wealth is created and are given the facts on the distribution of national income and its division between labor and capital. They are told that savings represent labor stored up by self-denial and that tools come from savings. It is emphasized that the value of man's work has increased in proportion to the increase in mechanical energy used and that as tools per worker increase hours per week decrease and real wages rise.

The material is presented in such a way that the workers can grasp it readily and then discuss it. The six-hour program is broken up into four 1½-hour sessions. Experience has shown that groups of about 25 are the most effective environment in which to present the data. The small group puts the leader in relatively close touch with all members of the group and encourages franker and less restrained discussion. It also permits release of resentment which is not likely to occur in a group so large the resentful person is unwilling to speak.

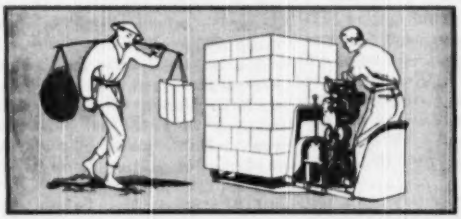
Visual presentation is an important part of the program. Liberal use is made of charts and slide films. These are especially helpful in getting across statistical material.

Props are also used to present ideas graphically. Toy products are used to demonstrate the superiority of the American living standard. Although population figures show that only one person in 15 is an American, Americans have three times as many automobiles as the rest of the world's peoples. To a member of the group chosen to represent Americans is given three toy cars and to 14 men representing all other people goes one auto. The American gets one toy telephone to one for the other 14 men. He also gets 14 bags of coffee to 14 for the other 14 men, since Americans consume half the coffee in the world. The demonstration continues with the distribution of toy radios, bath tubs, and other goods.

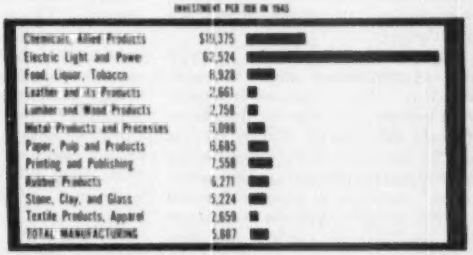
These methods have proved amazingly effective in getting across the basic facts of the American free enterprise system. The whole program is attracting attention. It is being made available to all utility companies throughout the country and plans are being worked out for making it available to all industries.

Question	Supervisor Group		Operating Group	
	Before	After	Before	After
Which has done most to improve living standards?				
Better tools and machines	75.0%	90.5%	33.3%	75.7%
Strong labor unions	8.3	0	61.2	21.6
Government help	0	0	0	0
Superior workers	16.6	9.5	5.5	2.7
After a company pays for materials, taxes, and other costs, who gets largest share of money left?				
Employees	85.0	100	27.3	90.9
Owners	15.0	0	12.1	6.1
Don't know	0	0	60.6	3.0
When a company adds new and better machinery does this reduce number of jobs?				
Yes, reduces jobs	25.0	0	50.0	18.2
No, does not	75.0	95.0	50.0	78.8
Don't know	0	0	0	3.0
Qualified answer no	0	5.0	0	0
Who gains from new and better machinery?				
Workers	20.9	12.5	5.5	24.3
Owners	4.0	4.2	30.6	6.1
Customers	8.5	12.5	13.9	10.8
All of them	66.6	70.8	50.0	56.8
In an average year do you think nearly all corporations make a profit?				
Yes, nearly all	86.0	35.0	100	51.5
No	14.0	65.0	0	45.5
Don't know	0	0	0	3.0
Do you feel government should regulate business pretty closely or is less regulation the better?				
More	0	0	26.5	12.1
Less	100	100	73.5	87.9
Are you for or against government ownership of the power companies?				
For	4.8	0	3.0	0
Against	95.2	100	97.0	100
If times get hard and prices fall should the government try to prevent wage rates from falling?				
Yes	19.1	10.0	28.5	15.2
No	80.9	85.0	71.5	78.8
No answer	0	5.0	0	6.0

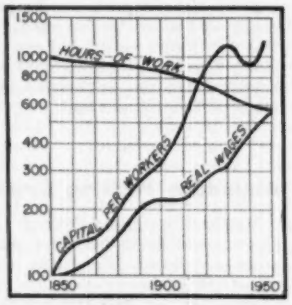
What Is the American System . . .



IN AMERICA machines do 94% of the work. Electrification of industry has done away with the necessity of hard labor


Chemicals, Allied Products $10,375
Electric Light and Power 62,524
Food, Liquor, Tobacco 8,928
Leather and its Products 2,661
Lumber and Wood Products 2,758
Metal Products and Processes 5,098
Paper, Pulp and Products 6,685
Printing and Publishing 7,558
Rubber Products 6,271
Stone, Clay, and Glass 5,224
Textile Products, Apparel 2,659
TOTAL MANUFACTURING 5,887

IT COSTS from $2,661 to $62,524 to make a job for one man. The average for all manufacturing industries amount to $5,887.



MORE CAPITAL invested per employee has raised wages and reduced hours

1929
$121 per capita
1938
$250 per capita
1948
$984 per capita
Government, by taking about 30¢ of every dollar of national income, limits investment in more and better tools

THE EVER LENGTHENING shadow of government spending has reached such proportions that it equals the total income of all the people in the western half of the U. S.

PRESIDENT TRUMAN, *right, poses with Gov Arthur B. Langlie of Washington, center, and Sen Warren G. Magnuson, Washington. In background is the Grand Coulee Dam*

Oklahoma 'Contract' Negotiations Broken Off, Chapman Tells Senate

THE CONTRACT negotiated by two Oklahoma electric utilities and Southwestern Power Administrator Douglas C. Wright has been killed by Interior Secretary Oscar L. Chapman. He announced his decision to a Senate subcommittee considering Interior appropriations.

Chapman suggested that a fresh start at negotiations might be made, aimed at a less comprehensive agreement between SPA and the companies. He said the contract Wright brought him for approval last December "would be contrary to federal public power policy." Attempts to adjust differences between Interior and the companies have met with no success, Chapman testified.

Reviewing the negotiations, Chapman said that company proposals did not comply with provisions of Section V of the Flood Control Act of 1944. Most violent disagreement came over service by SPA to present customers of the companies, particularly municipalities (EW, May 15, p 11). Admitting that an existing contract between SPA and Texas Power & Light Co did not meet all such "tests," Chapman said that only one municipally owned system was involved in the Texas agreement.

The Interior Secretary attacked provisions for payments by SPA to the companies for service to present customers of the companies as a "subsidy." President R. K. Lane of Public Service Co of Oklahoma, negotiating for his company and Oklahoma Gas & Electric Co, advised Chapman on April 7 that Interior's proposed amendments on this point were unsatisfactory.

"I considered this letter of rejection of the government's proposal as terminating this effort to negotiate a contract," Chapman said.

Interior also refused to consider a compromise which would prevent SPA service to municipal systems for three years. This suggestion was based on the theory that SPA would not have sufficient power to serve these customers anyway. But Chapman charged that such a scheme would violate preference provisions of the Flood Control Act.

By 1953, the Secretary told the Senators, SPA will have approximately 327,000 kw of load at 50% load factor. Present contracts amount to 257,000 kw of this load.

Chapman has advised Wright that new negotiations might be started. But these should be aimed toward simple "wheeling" and exchange arrangements of a temporary nature, the Secretary has recommended. Chapman has indicated that Interior will probably seek to expand SPA's existing system.

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Will Add 100,000 Hp

Carolina Power & Light Co has ordered a second 100,000-hp unit for its Goldsboro Plant at Quaker Neck, N. C.

Good Customer Relations Called Best Defense

Good customer relations are the best defense against competition. This was emphasized at the recent Industrial Power Sales Conference of the Southeastern Electric Exchange at St. Petersburg, by W. Paul Lyman, Carolina Power & Light Co.

Lyman said that the best way to maintain good customer relations is to give good service at reasonable rates and make frequent contacts with customers. Large industrial plants which utilize a large volume of process steam now have the time and engineering talent to work out their heat balance problems. In most cases the money is available at low interest rates to make the installations indicated, he asserted.

J. H. Coates, Ebasco Services, Inc, said that many utilities are going through the evolutionary process of simplifying their industrial rate structure and eliminating some of the special rates. There is also a definite trend towards more general service rates rather than separate categories of industrial rates.

The combustion gas turbine is particularly favorable in regions where water is scarce or costly, according to C. M. Wright, General Electric Co. He said that it would be well adapted to the type of steam turbine generating plant which utility companies build to supply either a single large industry or a group of smaller industries with both process steam and power.

Big industrial customers believe in electric power and want to use more of it, B. J. Martin, *Electrified Industry*, asserted. He added that each industry can profitably invest in cost cutting studies an amount as big as its power bill.

J. F. Morton, New Orleans Public Service, said that a survey of 89 industrial plants revealed that in nearly every instance, the load factor for lighting was higher than it was for power usage. One reason for this was the fact that the lighting kw demand was practically constant from 6 am until 4 pm compared with the variable demand established by the power load.

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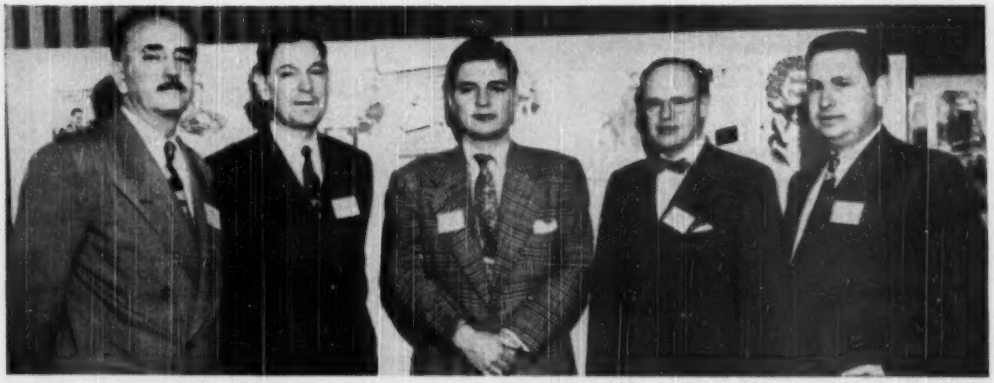
Abandons Heating System

A request by Dayton Power & Light Co to discontinue its hot water heating plant system in Washington Court House, Ohio, immediately has been approved by the State Public Utilities Commission. The company claimed it was losing money in supplying the service.



NEW PUAA OFFICERS are Walter G. Heren, Union Electric Co of Missouri, third vice president; Paul L. Penfield, Detroit Edison Co, second vice president; William B. Hewson, Brooklyn Union Gas Co, president; John E. Canfield, Wisconsin Power & Light Co, first vice president; and Mead Schenck, Interstate Power Co, treasurer. Absent when picture was taken was George G. Hanel, Connecticut L&P Co, secretary

PUAA Told Salesman's Market Now Prevails in Electric Industry

A SOLID MEAL of professional techniques garnished with the importance of preserving the free enterprise system and a dessert of entertainment features was the menu offered the Public Utilities Advertising Association at its annual convention. Over 150 attended the meeting at Kansas City on May 11-12.

Denying that the industry is in a buyers' market, J. Stanford Smith, manager, advertising and sales promotion division, Apparatus Department, General Electric Co, asserted that the industry is actually in a saleman's market. He outlined four principles necessary for the industry in this market. These include: 1. Adequate funds and personnel to do the selling job, 2. A sincere interest in the welfare and prosperity of customers, 3. A certainty that the industry keeps up with the times, 4. Harder work on the public aspects of the job.

Electric companies must provide the climate and tools for their advertising managers if they are to do a successful job. This opinion was expressed by Joseph F. Porter, vice president, Kansas City Power & Light Co. He believes that the companies must quit being afraid of politicians and publicity because the industry is doing a good job and has nothing of which to be ashamed. He advocated giving the advertising manager organizational status, making him a member of policy shaping committees, and giving him sufficient funds.

William Handlan, Monongahela Power Co, was elected editor of the *PUAA Bulletin*. C. Fred Westin, Public Service Electric & Gas Co, will be in charge of the 1951 Better Copy Contest.

Winners of the 1950 Better Copy Contest were announced. Companies are classified by number of customers served. Group A includes those with less than 125,000 customers; B, 125,000 to 299,999; C, 300,000 or more.

Unless otherwise stated the companies listed in each group are winners of first, second, and third awards, respectively. Only awards won by electric or combination companies are listed.

Series of three to five newspaper ads on a public relations subject—A: Delaware P&L Co, Hawaiian Electric Co, Iowa Electric L&P Co; B: Ohio Public Service Co, Kansas City P&L Co, Arkansas P&L Co; C: Cleveland Electric Illuminating Co, Commonwealth Edison Co, Detroit Edison Co.

Series of three to five newspaper ads promoting the use of electric service—A: Hawaiian Electric Co, Iowa Electric L&P Co, Tampa Electric Co; B: Indianapolis P&L Co, Central P&L Co, Kansas City PL Co; C: Northern States Power Co, Commonwealth Edison Co, New York State E&G Corp.

Single newspaper ad on any subject—A: Central Illinois E&G Co, Western Massachusetts Electric Co, New Jersey P&L Co; B: Toledo Edison Co, Narragansett Electric Co, Pacific P&L Co; C: Northern States Power Co, San Diego G&E Co, Consolidated Edison Co.

Employee magazines—A: Hartford Electric Light Co, first; Washington Water Power Co, second; B: Kansas City P&L Co, first; Wisconsin Electric Power Co, second; C: Detroit Edison Co, first.

Employee newspapers—A: Potomac Edison Co, Central Arizona L&P Co, Iowa Electric L&P Co; B: Mississippi P&L Co, Texas P&L Co, Pacific P&L Co; C: Union Electric Co of Missouri, Cincinnati G&E Co, Public Service E&G Co.

Direct mail to farm or residential customers—A: Washington Water Power Co, Western Massachusetts Electric Co, Potomac Edison Co; B: West Penn Power Co, New Orleans PS Co, Texas ES Co; C: Public Service Co of Northern Illinois, Detroit Edison Co, Georgia Power Co.

Direct mail to commercial or industrial customers—A: Potomac Edison Co, first; Western Massachusetts Electric Co, second; B: New Orleans PS, West Penn Power Co, Rochester G&E Corp; C: Cincinnati G&E Co, Alabama Power Co, Georgia Power Co.

Special booklets, pamphlets, circulars sent to employees—A: Hawaiian Electric Co, first; Iowa Electric L&P Co, third; B: West Penn Power Co, Kansas City P&L Co, Connecticut L&P Co; C: Consolidated Edison Co, Dayton P&L Co, Alabama Power Co.

Window display—A: St. Joseph L&P Co, first; West Texas Utilities Co, second; B: Kansas City P&L Co, Indianapolis P&L Co, Wisconsin PS Corp; C: Consumers Power Co, Consolidated Edison Co, Georgia Power Co.

Interior display—A: Cambridge Electric Co, second; West Texas Utility Co, third; B: Shawinigan W&P Co, first; Puget Sound P&L Co, third; C: Cincinnati G&E Co, Pennsylvania Electric Co, Union Electric Co of Missouri.

Outdoor advertising, large units—B: Montana Power Co, first; Dallas P&L Co, second; C: Northern States Power Co, first; Public Service E&G Co, second.

Outdoor advertising, small units—A: Winnipeg Electric Co, Southwestern PS Co, Central Arizona L&P Co; B: British Columbia Electric Co, Toledo Edison Co, Utah P&L Co; C: Pacific G&E Co, Duquesne Light Co, Commonwealth Edison Co.

Annual report to stockholders—A: Iowa Electric L&P Co, first; Pennsylvania Power Co, second; B: Wisconsin P&L Co, Jersey Central P&L Co, Atlantic City Electric Co; C: Illinois Power Co, first; Union Electric Co of Missouri, second.

Radio advertising, one classification,—New Orleans PS, Duquesne Light Co, Indiana & Michigan Electric Co.

Complete programs—A: Washington Water Power Co, Central Arizona L&P Co, Hawaiian Electric Co; B: Ohio Public

Service Co, British Columbia Electric Co, Iowa P&L Co; C: Detroit Edison Co, first; Northern States Power Co, second.

Films, one classification—Pacific G&E Co, second; Consolidated Edison Co, third.

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N. Y. Meter Engineers Discuss Obsolescence

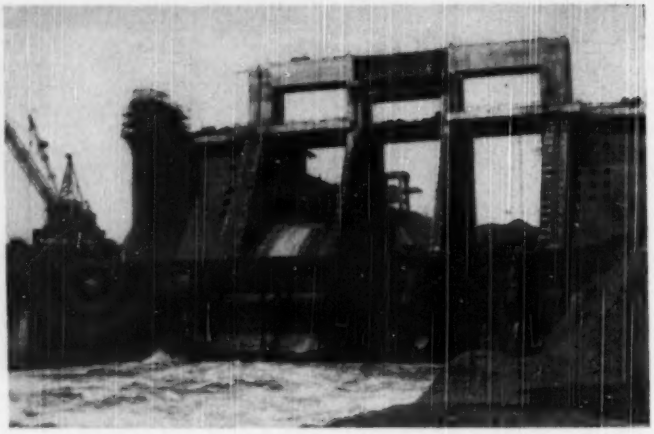
That load and consumption tests of 5-amp watthour meter installations are a desirable adjunct to economic analysis regarding their obsolescence was a firm conclusion of the Meter Engineers Committee of New York State in a New York meeting, May 11 and 12.

One company is systematically discarding all except those needed for sign loads, bungalows, etc. Another is putting them back where consumptions are under 200 kwhr per month and still another finds little danger of burnout up to 400. Discolored dials were recognized as a universal warning of overloading, one company finding 20% of the 5's in that condition. Sampling of consumer load curves with recording ammeters was advocated as a good guide. One company found 1% more registration with 5's than with 15's on small use customers and another found 2% more.

Concensus was in favor of a single 2-kv test voltage for insulation and clearances in both new and old meters with the 1½ kv of the Code for Electricity Meters viewed as a minimum. Justification for difference in specifications and application of service drop and service entrance cable was questioned. Code numbering of customer meters is practiced in a limited way but was acknowledged to have value when inventories are handled on tabulating machines.

Compensated metering is used by Consolidated Edison Co of New York, C. V. Morey reported, only for special contracts (transportation, Navy, etc).

New products displayed by manufacturers included a whole new family of meter socket boxes and integral troughs by Code Electric Products; the lower half of the covers can be detached to test the socket meter in place. Anchor Manufacturing reported a heavy-duty trough socket for 200-amp circuits served by 50-amp meters. Westinghouse had a new transformer socket and a combination polyphase watthour and thermal kva demand meter. Eastern Specialty offered a micro-switch for meter testing, a light-weight field check set for current transformers, and a resistance-type load box patterned after the Philadelphia Electric design. General Electric presented a clip and jumper scheme for testing the I-50 meter without removal from the socket.



FINAL SECTION in the superstructure of the Davis Dam spillway nears completion as the Bureau of Reclamation speeds work on this newest dam on the Colorado River. Concrete is being placed in two sections of the spillway. Section at the left is completed

Engineers Told of Responsibility to Save Democracy and U. S. Way

THE RESPONSIBILITY of the engineer for preserving democracy and the American system of free enterprise was pointed out to the American Institute of Electrical Engineers at its Great Lakes District meeting. Over 500 attended the meeting held May 11-12 at Jackson, Mich.

We are not working at our democracy; that is all that is wrong with it, J. F. Fairman, AIEE president, asserted. As evidence he cited the members' own failure to vote in AIEE elections. In elections for national officers only 5,000 of 30,000 members vote. In balloting on issues of grave importance to members, issues which members themselves have raised, only 30% voted in one instance and only 10% in another.

R. S. Peare, vice president, General Electric Co, said that we will not see the greatest nation on earth marching down the road to moral, political, and economic bankruptcy singing the Hallelujah chorus if engineers and professional men accept their responsibilities over and above their technical and professional fields. This, he explained, requires that each person individually undertake a person-by-person, community-by-community educational program in the American economic system. This means hard work, evenings away from home and family, talking to friends, and carrying on a never ending job.

Increased range of temperatures and pressures and the auxiliaries available today have increased the responsibilities of engineers. They now have an opportunity for more flexibility in their plant design, J. H. Foote, president, Commonwealth Associates, said in discussing modern power supply facilities. The part a plant is to play in the overall operation of a system is the criterion of the design rather than design for the lowest cost or best economy. Real test of a plant is whether it fits a system.

Cut in substation costs of up to 1/3 for the structure and ¼ for the entire substation was reported by E. V. Sayles, Consumers Power Co. The savings were effected through use of "erecticon" steel sections which add to flexibility and ease of construction and to the installation of control circuits in overhead conduit instead of underground.

Generator voltages as high as 27 kv are now being considered, A. A. Johnson, Westinghouse Electric Corp, asserted. Some of these will be connected to existing distribution or sub-transmission systems, using series reactors.

Marked reduction in customer interruptions following application of a ground fault neutralizer on a 34.5-kv system was reported by H. H. Brown, Wisconsin Michigan Power Co. Reporting on a survey covering 51 systems, E. W. Atherton, Railway & Industrial Engineering Co, said that 90% of neutralizer applications had resulted in good or excellent results.

TOMLINSON FORT, left, Westinghouse Electric Corp, chats with Franklyn Haydecke, Public Service Electric & Gas Co and president of the New Jersey Utilities Association, and Earl J. Mincrey, right, South Jersey Gas Co and member of NJUA program committee

165 Mw Capacity Needed by 1965, N. J. Group Told

Future markets for the electrical industry will require 165 Mw of generating capacity by 1965, necessitating 10 Mw per year capacity to be added, according to Tomlinson Fort, manager, Apparatus Sales Department, Westinghouse Electric Corp. This was one point on a curve for projection of electrical trends. He spoke on the subject "Looking Ahead 50 Years in the Electric Industry" at the annual spring meeting of the New Jersey Utilities Association at Absecon, N. J. on May 12.

Other points mentioned for the curve were: 600 Mw turbines with high pressure-high speed and low pressure-low speed sections; nuclear power substitute for boiler and fuel but steam generation will be retained; 400-kv transmission; 15 million-kva circuit breakers; high-frequency electric power for food processing; burn-out proof and lifetime lubricated motors; and a material for application on a ceiling to produce light.

Dr Ralph Bown, director of research, Bell Telephone Laboratories, spoke on "Research Problems of Network Television." Comparing the respective values of coaxial cable and radio relay for transmission of network television, Bown said that sufficient background of day-in and day-out operating experience between the two is still lacking. In looking forward he mentioned that a service will be provided whereby a person using video can listen and talk to where he wishes, similar to present person-to-person telephone calls.

William F. Drake, director of group annuity sales, Prudential Insurance Co, in speaking on "Present Day Pension Fund Problems" suggested that employers obtain advice from a source knowing facts on invested pensions and write out the plan for a benefit. In addition he predicted more rational approach to pension plans.

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Lake Mead Water Level Will Be Lower Than in '49

Lake Mead is expected to rise about 39 ft by the end of July as the Rockies send their annual flood of melted snow down the Colorado River, E. A. Moritz, regional director for the Bureau of Reclamation at Boulder City, Nev., said recently. Even with this predicted inflow, the reservoir will still be 7 ft below its level on July 31, 1949.

A mean forecast compiled by the bureau's regional office of river control indicates that about 9.1 million acre-ft will flow into the lake behind Hoover Dam during the April-July period. This catchment will be about 1.6 million acre-ft less than last year's and about 600,000 acre-ft less than the 37-year average for the same period.

Moritz pointed out, however, that "this year's run-off, although a little less than the long-time average, will assure sufficient water to meet all firm irrigation, domestic, and hydroelectric requirements throughout the coming 12 months of next year."

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To Sell Gas Properties

Arkansas Power & Light Co has agreed to sell its natural gas distribution properties in 24 cities and towns to a new gas company that is being organized to serve eastern Arkansas. Sale price will be "between $2 and 3 million," AP&L Pres C. H. Moses said.

Street Lighting Methods Discussed at GE Parley

Fluorescent street lighting will come along as fast as it is wanted. That, in effect, was what some 150 utility and municipal engineers were told at the street lighting school staged by General Electric at its Lynn, Mass, plant, May 9 and 10. The necessary equipment is available in practical form. The next step must be application, providing experience from which will come improvements in design and performance, just as has been the case with every new development.

In the meantime established methods of street and highway illumination are not standing still. Shown and explained to the "students" were improved designs of reflectors and refractors incorporated in modern luminaires to utilize more effectively the lumen outputs of incandescent and mercury lamps. It is to be expected that with increasing use of mercury lamps in industrial applications—a market about 20 times as large as street lighting—the price of these lamps will be reduced. This, plus the raising of their life ratings now in progress, means that the mercury arc will become an increasingly larger factor in street lighting.

But street lighting progress is slow, despite the number of modern installations now being made. A. F. Dickerson announced the theme of the meeting as "Comfortable Seeing" and said that one of the worst offenders against that aim was the radial wave reflector. This unit was invented 43 years ago and is hopelessly out of date. But it is still being manufactured and bought—not sold—by the thousands. This, said Dickerson, indicates that full advantage is not being taken of modern street lighting facilities.

The program of the two-day meeting was comprehensive and intensive. It covered available equipment, trends of development in light sources, techniques of application, business aspects of street lighting, and ways for its promotion. Included were inspections of full-scale demonstration installations of high and low level fluorescent lighting and of mercury lighting in luminaires of latest design.

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Utility Buys Building

El Paso (Texas) Electric Co has purchased the Martin Building in El Paso for its headquarters and changed its name to "Electric Building." The building's ground and first two upper floors had been leased by the company for the past 20 years.

YIELDS (%) — Operating Electric Utility Securities

Quality	Bonds			Preferred Stocks			Common Stock		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1950									
May 11	2.62	2.64	2.73	3.76	4.00	4.34	5.13	5.96	6.72
May 4	2.62	2.64	2.73	3.76	4.00	4.35	5.19	5.96	6.67
1949									
May 9	2.70	2.78	2.91	4.02	4.32	4.69	5.60	6.46	7.76
May 2	2.70	2.78	2.91	4.05	4.36	4.70	5.71	6.53	7.83
END OF QTR.									
1st 1950	2.59	2.61	2.71	3.78	4.01	4.36	5.22	5.85	6.67
4th 1949	2.59	2.61	2.72	3.85	4.06	4.46	5.37	6.15	7.01
3rd 1949	2.61	2.65	2.77	3.88	4.15	4.54	5.55	6.47	7.51
2nd 1949	2.69	2.75	2.88	3.98	4.26	4.66	5.94	6.96	8.14

Data: Reis & Chandler, Inc.

Yields on several new utility bond issues rose following price breaks in the past two weeks.

Banking syndicates were terminated on offerings of $26 million of Public Service Electric & Gas Co and $30 million of Potomac Electric Power Co bonds. In the free market blocks of the undistributed Public Service bonds sold with yields up to 2.70%, compared to the offering yield of 2.665%, and the Pepco offerings also were exchanged at yields above the 2.70% offering basis. Only about a fourth of Public Service's original issue was placed at the issue price.

Oklahoma Gas & Electric's 30-year first mortgage bonds were sold May 15 on a cost basis of nearly 2.80%. Reoffering was to be made to yield 2.77%. The yield boosts accompanied a downward drift in the price of Treasury obligations as the Federal Reserve System continued to sell.

Common stock sold during the week of May 8 to 15 included $8,500,000 by Dayton Power & Light Co, $10,305,000 by Pepco, and $2,250,000 by New England Gas & Electric Association, all new money. Dayton P&L offered rights at one for seven on 283,333 shares at $30; Pepco's offering was 710,700 shares at $14.50, with rights on the basis of one for five; and New England G&E offered rights at one for eight, with an oversubscription privilege, on 173,126 shares at $13.

Scheduled for the week of May 15-22, in addition to the Oklahoma G&E bonds, were $58 million of first mortgage refunding bonds by Ohio Edison Co, $25 million of new money preferred stock by Southern California Edison Co, and $600,000 of new money preferred by Maine Public Service Co.

Security Offerings by Electric Utilities
(In Thousands of Dollars)

	New Money	Other
WEEK OF MAY 8-15		
Bonds	$10,000	$20,000
Common Stock	21,055	.....
Totals	31,055	20,000
SCHEDULED WEEK OF MAY 15-22		
Bonds	10,000	65,500
Preferred Stock	25,600	.....
Totals	35,600	65,500

'Typical' Light Bills Back to 1948 Low, Says FPC

Average residential and commercial electric light bills dropped back at the beginning of this year to the record low of Jan 1, 1948, the Federal Power Commission reports in its annual publication on typical electric bills for cities of 50,000 population or more.

Average bills for commercial power and industrial services declined during 1949 from the levels of 1948 but exceeded the lows of 1947 and 1941. FPC attributed the difference to the operation of fuel, tax, and cotamodity clauses covering increased production costs.

Data on typical residential bills for 206 cities served by 145 utilities show that the average bill for 100 kwhr decreased during 1949 from $3.68 to $3.64. On Jan 1, 1940, the average bill was $3.88 and in 1924 $6.18.

During the year residential rates were reduced in 35 of the 206 cities. In 151 cities rates remained unchanged, and in the remaining 20 they were increased. In 1948 rates generally were increased in 43 cities, reduced in 16, and unchanged in 147.

Only 19 cities had increases in the 100-kwhr bill over the 1940 level and 156 had decreases. Decreases of 75¢ or more per month from the 1940 average occurred in 20 cities, and 38 had reductions of 50¢ to 75¢ a month. The average 100-kwhr bill fell 6.2% in the 10-year period.

For the 250 and 500-kwhr monthly bills 145 cities showed declines from 1940. The nation's average monthly bill for 250 kwhr dropped 3.4% in the 10 years and for 500 kwhr decreased 3.6%.

FINANCIAL BRIEFS

A $26-million loan has been granted by the International Bank for Reconstruction and Development to Mexican Light & Power Co, Ltd. Mexlight will use $10 million of the proceeds to repay a short-term loan from the bank and the remainder for a four-year expansion program. The 25-year loan bears 3½% interest plus a 1% commission allocated to the bank's special reserve fund. In January the World Bank lent Mexico's Federal Electricity Commission $24.1 million.

Stock in Pacific Power & Light Co, purchased from American Power & Light Co in February by an investment group headed by A.C. Allyn & Co, Inc, and Bear Stearns & Co, is expected to be offered to the investing public shortly after Aug 6, PP&L Pres Paul B McKee has announced. The company already has sold to a group of investment firms $9 million in 30-year 3% bonds. Proceeds of the latter sale will be used to retire bank loans incurred in financing the company's 1948-49 building program.

Stockholders of Public Service Co of Colorado will be asked at a special meeting May 22 to approve a two-for-one split of the common stock and to restate the authorized cumulative preferred stock at 375,000 shares. A two-thirds vote of the outstanding common and preferred shares is required for approval of the split.

New Federal Power Commission competitive bidding requirements will become effective May 25. Public notice was given earlier (EW, Feb 13, p 69) of the proposed amendments to the commission's general rules and regulations. In general, the new rules parallel bidding requirements of the Securities and Exchange Commission.

Cordova, Alaska, has voted approval of a $500,000 revenue bond issue to buy the power, light, water, and telephone systems of Alaska Public Utilities and to construct a hydroelectric plant. The total purchase and construction program is expected to involve $1 million. The remaining funds are being sought from the federal government.

Water Policy Commission Slates Regional Meetings

Regional conferences will be held during the next two months to permit local water users to present ideas to the President's Water Resources Policy Commission. Five area meetings from Arkansas to the Pacific Coast already have been scheduled for June. Two others—in New England and the Southeast—will be held in July.

Definite dates have been fixed for five June conferences: Sioux City, June 12-13; Spokane, June 16-17; San Francisco, June 23-24; Denver, June 27-28, and Fayetteville, Ark., June 30-July 1.

New England and Southeast dates have not yet been set, but the meetings will be held at Springfield, Mass., and Atlanta, Ga.

Commenting on the purpose of the regional meetings, Commission Chairman Morris L. Cooke said, "the area conferences will be informal, with a view to developing from representatives of state and local government agencies and citizen groups constructive suggestions on which sound national water policy can be based."

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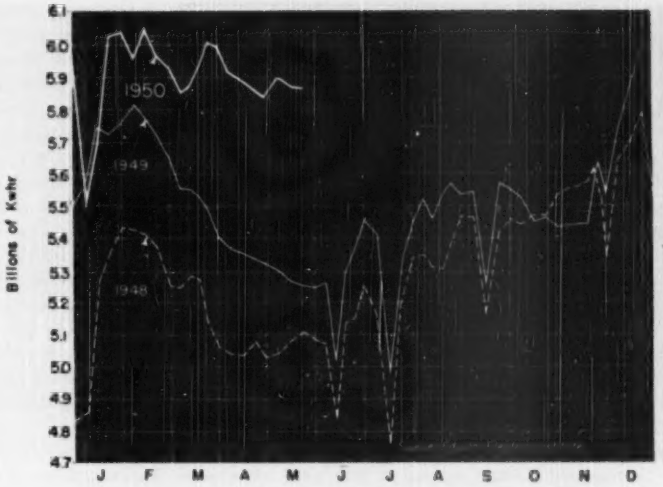
N. Jersey Seizes Utility After Week-Long Strike

Striking Public Service Electric & Gas Co employees went back to work May 16 when New Jersey's Gov. Alfred E. Driscoll seized control of the company under the state utility anti-strike law.

It was the first time New Jersey had taken over electric generating facilities since the original law was passed in 1946. The act had been invoked 20 times for other types of utilities. New Jersey Bell Telephone Co was still under technical state supervision last week following threat of a strike over wage differences.

Most of Public Service's 4,400 electrical workers were involved in the walkout, started May 9 by locals of the International Brotherhood of Electrical Workers, AFL. Supervisory employees took over operation of plants and substations, and service was maintained except for some abnormal outages. Between 20 and 30 homes reported no service.

The strike followed failure to agree on a new contract to replace one that expired May 1. The union sought a 5% wage increase, and the company offered 2%. The dispute now will be submitted to compulsory arbitration by a board appointed by the governor, composed of representatives of the union, company, and the public.



Output Week Ended May 13—5,864,326,000 Kwhr

Weekly Output, Millions Kwhr

1950	1949	1948
May 13 5,864	May 14 5,257	May 15 5,109
May 6 5,872	May 7 5,284	May 8 5,087
Apr 29 5,902	Apr 30 5,304	May 1 5,042
Apr 22 5,846	Apr 23 5,326	Apr 24 5,027
Apr 15 5,863	Apr 16 5,343	Apr 17 5,087
Apr 8 5,898	Apr 9 5,360	Apr 10 5,633
Apr 1 5,992	Apr 2 5,378	Apr 3 5,037
Mar 25 5,993	Mar 26 5,404	Mar 27 5,065
Mar 18 6,015	Mar 19 5,496	Mar 20 5,145
Mar 11 5,937	Mar 12 5,531	Mar 13 5,285
Mar 4 5,879	Mar 5 5,552	Mar 6 5,293

Percent Change from Previous Year

	May 13	May 6	Apr 29
New England	+13.9	+15.1	+18.1
Mid-Atlantic	+ 9.1	+10.6	+11.3
Central Industrial	+12.8	+12.0	+12.3
West Central	+ 9.5	+12.5	+ 9.9
Southeast	+13.0	+12.0	+11.4
South Central	+16.0	+12.1	+ 8.6
Rocky Mountain	+11.3	+ 9.3	+10.6
Pacific Coast	+ 9.4	+ 7.9	+ 9.3
Total United States	+11.6	+11.1	+11.3

MEETINGS

American Institute of Electrical Engineers
Conference on Telemetering, Benjamin Franklin Hotel, Philadelphia, Pa., May 24-26; Summer General Meeting, Huntington Hotel, Pasadena, Calif., June 12-16.

Pennsylvania Electric Association
Transmission and Distribution Committee, Spring Meeting, Alexander Hotel, Hagerstown, Md., May 25-26; Joint Meeting, Traffic Safety Committee, May 26; Relay Committee, Castleton Hotel, New Castle, Pa., June 15-16; Electrical Equipment Committee, Abraham Lincoln Hotel, Reading, Pa., June 19-20.

Northwest Public Power Association
Accounting Section, Winthrop Hotel, Tacoma, Wash., May 25-26.

Edison Electric Institute
Transmission and Distribution Committee, Cosmopolitan Hotel, Denver, Colo., May 25-26; Annual Convention, Auditorium, Atlantic City, N. J., June 5-7.

Pacific Coast Electrical Association
Annual Convention, Mapes Hotel, Reno, Nev., May 31-June 2.

National Association of Electrical Distributors
Annual Convention, Convention Hall, Atlantic City, N. J., June 12-16.

Canadian Electrical Association
Annual Convention, Manoir Richelieu, Murray Bay, Que., Canada, June 15-19.

American Society of Mechanical Engineers
Semi-annual Meeting, Hotel Statler, St. Louis, Mo., June 19-23.

American Society for Testing Materials
Annual Meeting with Exhibit of Testing Apparatus and Related Equipment, Chalfonte-Haddon Hall, Atlantic City, N. J., June 26-30.

CIGRE
International Conference on Large Electric Systems, Paris, France, June 29-July 8. I. W. Gross, secretary, American Gas & Electric Service Corp., 30 Church St., New York 8, N. Y.

World Power Conference
London, England, July 10-12. H. C. Forbes, secretary, Consolidated Edison Co., 4 Irving Place, New York 3, N. Y.

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Monthly, Yearly Record Set by Output in March

A monthly output record was set in March, when the nation's electric utilities produced 26,997,034,000 kwhr, 0.5% above the previous high of January, 1950.

Production for the year ended March 31 was the highest for any 12-month period to date, 295,882,712,000 kwhr. This was 0.8% more than the previous maximum for the year ended Feb 28, 1950, and 3.3% more than production during the year ended March 31, 1949.

As a percentage of March total production water power output decreased slightly from 32.9% last year to 32.3% this year. March hydro output of 8,729,061,000 kwhr, however, set a new monthly record. It was 7.3% over the production of March, 1949.

WASHINGTON COMMENT

RONALD D. ROSS

A NEW ATTEMPT to spell out federal power and water policy is getting some attention from the electric utility industry. The policy is proposed in a bill introduced recently by Republican Senator Arthur V. Watkins of Utah.

Here, in brief, is what the Watkins bill would do. It would permit establishment of interstate water and power users' associations to contract with the federal government for the construction of water and power projects. Reclamation and the Corps of Engineers would construct the projects, but the new associations would own, operate and maintain the projects, using power and water revenues to reimburse the government.

As Senator Watkins points out, this is not a new concept. It's really a return to the policies set out in the early reclamation laws of nearly half a century ago. The idea—from which New and Fair Dealers have strayed so far—was that federal water projects would be purchased by the water users. When they had paid for a project, they would own it.

New or old, this system has important merits. Regardless of how extensive federal water projects became, there could not be a federal power empire in the administrative form of today's far-flung, yet highly centralized, operations. Washington bureaucrats would not direct power programs throughout the West. Reclamation projects would have what Senator Watkins terms "grass roots management."

However, there would be other features which might offset the obvious advantages unless they were ironed out.

The associations, under the present bill, would be incorporated bodies chartered by the Secretary of the Interior. The very important matter of cost allocation would be determined by the Secretary of Interior or the Secretary of the Army, depending on which federal agency constructed the project.

Preference would be given public bodies and co-ops in the purchase of power, and all revenues from sale of power would be subject to strict federal regulation until the government's expenditures had been repaid. The associations would be tax exempt.

This, then, would not create a new variety of power operation but merely a new kind of public power. For several decades, until projects were paid off, these proposed associations would be under pretty close federal guidance. Although different in certain basic features, they would more closely resemble REA-financed co-ops than other types of existing public power systems.

One problem the associations would face would be that of finding firm steam power to support hydro. It's likely that federal funds would be sought to construct steam plants. Failing this, the associations perhaps would follow Southwestern Power Administration's example and acquire steam power financed by REA loans.

Would the Watkins bill settle the old issue of private vs. federal power, as some hope? The answer appears to be no. Such legislation, as it is now written, seems to promise more confusion, rather than clarity.

Congress, of course, is not going to take a very long, or very hard, look at the Watkins bill this year. This is an election year and only essential bills will get much hearing beyond this point. Meanwhile, there is an administration-directed embargo on federal water policy legislation. That's been laid down in anticipation of the report of the President's Temporary Water Resources Policy Commission, due Dec 1.

The Commission should, and undoubtedly will, study the Watkins plan. It is a significant effort toward a worthy end, the writing of a national water power policy. There would be little real cause for the industry to rejoice, however, if this policy were adopted without clarification of many of its present provisions.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Gas masks are required, by one utility of its operators, to be worn for 15 min. once every year; they are designed to permit the use of eyeglasses.

Soot from stoker-fired boilers is not too abrasive but is more effective than pulverized-coal flyash for "sand"-blasting turbine blades to remove deposits.

Cranes were used to place every piece of equipment in a recent power plant except the stator which was skidded in.

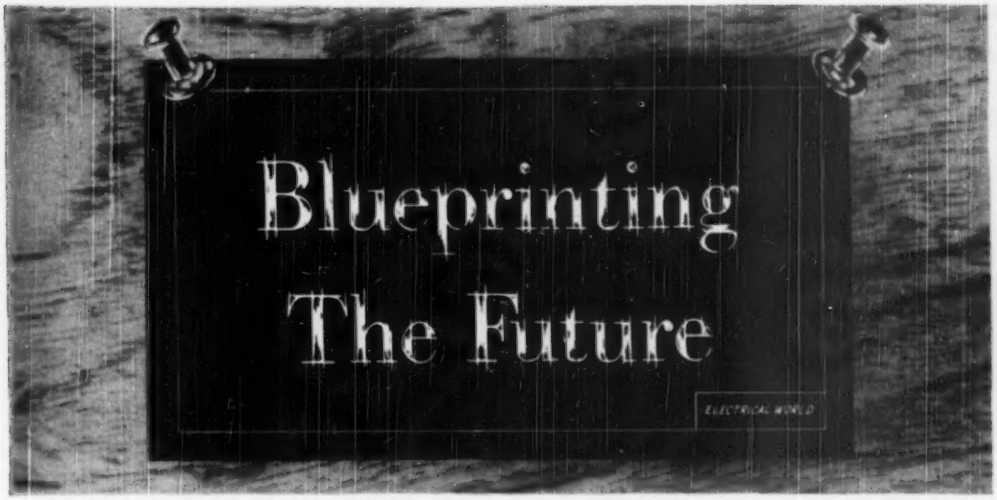
Low tangential strength of wrapped insulation as compared with radial and perpendicular dielectric strength is the dominant factor to guide both the design and the workmanship on cable splices and terminations.

Correlated information about modern current transformer characteristics and relay performance is available, but too few engineers capitalize it.

Acid-cleaning of boiler, superheater and economizer tubes is common but still less so than turbining, wire-brushing and washing with water.

Fringe areas are best for starting adoption of higher distribution voltages. It is easier to accomplish there. It eases the worries about long primaries in thin area having occasional concentrations and poor regulation.

Multiple street lamps are rated on a mean lumen basis, series lamps on an initial lumen basis.



The Political Setting

IN the next 15 years the American economy seems bound to have an imposing growth. Along with prospective population gains, key national policies point in this direction. At home, we have a national policy, embodied in law, of maximum employment for a rapidly growing labor force. Abroad, we have undertaken to defend and aid the development of the rest of the free world. This is a political setting conducive to rising economic activity. Temporary drops in business may nevertheless take place. But the general trend clearly seems destined to be upward.

The political setting also favors a gradual rise in prices. Despite attempts at economy, expenditures for the cold war and for larger welfare programs are likely to keep the federal budget unbalanced for many years. This will mean further deficit financing and inflation of the money supply. Meanwhile, it will still be good politics for any federal administration to support farm prices and to encourage higher industrial wages.

Under these conditions, powerfully organized labor unions will almost surely be able to win annual wage increases which exceed the gain in worker productivity. While the big postwar wage "rounds" are unlikely to be repeated, wages may well go up, on the average, 3% a year. Unless there is an unforeseen spurt in worker effort, productivity will not rise over 1.7%. The logical result would be about 1% yearly increase in the price level.

Rising activity and rising prices will not bring easy profits for business. The strongest upward pressures on the economy are Big Labor and Big Government. Consequently most of the rise in national income is very likely to be drawn off in higher wages for workers in government and industry, and in expanded welfare programs. The squeeze on business profits will continue. Profitable operations will require increasing effort in two directions: (1) Higher wage cost must be offset by more efficient equipment; (2) the public must be "sold" the idea that profits are necessary to pay for this modern equipment.

For the electrical industry this means that equipment costs will continue to rise but increasing labor rates will stimulate commercial and industrial sales. In the field of consumer buying there will be more funds in the hands of the minimum bill customer to spend for semi-essential appliances and lighting facilities. Shorter working hours growing out of increased productivity will produce more commercial activities in the recreational field.

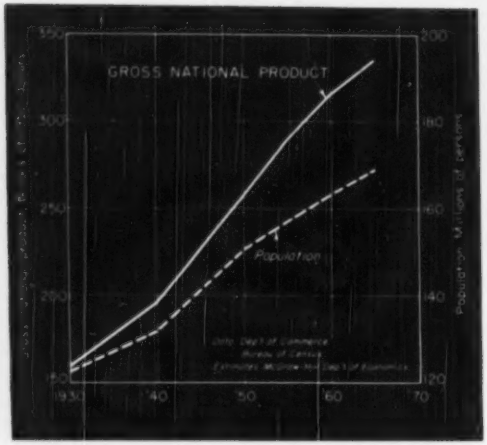
Growth of government will tend to maintain or increase the pressure on the investor-owned power industry. This will be accentuated by lack of economy in federal expenditures. With such an outlook as this, no short term measures to stop the invasion of government power can be very significant. Planning and carrying out an all-inclusive long-range program of public education appears to be the only potentially effective solution.

The complexity of these problems in the political, economic, and engineering field lead to the conclusion that the industry must concentrate on personnel relations. Selection, training and advancement of men and women to provide good management, faithful service, and active support of the industry is essential. Utility regulation will lose some of its political aspects and move further in the direction of sound economics. State commissions will be more sensitive to federal encroachment and work toward the protection of utilities coming within their jurisdiction.

Continued pressure upon the cost of supplying electric service will stimulate economies in power system facilities and operating practices. Such cost controls can provide an effective barrier against the inflationary characteristics of the future economy.

One thing is certain, the battle between politics and sound economics will be won or lost in the next 15 years insofar as the electrical industry is concerned.

The American Economy—Prospects for Growth, 1950-1965



OUTLOOK FOR THE 60'S—More goods for more people

BY 1965 the American economy will be producing $335 billion of goods and services per year, nearly a third more than in 1950. Population will reach 170 million, up 12%. There will be 4½ million more people working. But they will work shorter hours. And the bigger national product will be turned out with only a nominal rise in total manhours worked—but with much more electric power per worker. For business is likely to add over $20 billion of capital equipment per year. The striking thing about this preview of 1965* is that, despite the tremendous expansion of the '40's, the national output promises to grow almost another third by 1965.

Past periods of expansion, like the 1920's, have generally been followed by severe depressions which slowed the long term growth of the economy. But no major depression seems likely in the period just ahead. Political factors (p 99) and an unprecedented surge in population are both working to minimize any halting in business activity and keep the trend moving upward.

Population Growth . . . Population growth will be one of the key forces making for a greater national product. An increasing population creates demand for an increasing flow of goods and services. And more people also mean more workers to turn out the goods. That's why the population trend deserves careful analysis.

In recent years population has consistently run ahead of the official estimates. It seems clear that higher incomes and more economic security have led people to get married earlier and have bigger families than was formerly the fashion. No one can tell how long this vogue will continue. But it seems reasonable to assume a high rate of marriages and births for the years ahead.

The population forecast used in this study is based on these optimistic assumptions. It is supported by the general expectation of high employment, rising wages and increasing security programs. It is also supported by the trend of medical science.

Our labor force will probably rise in line with total population. The social trend is toward a greater proportion of women working. And this will largely offset reduction in the proportion of men at work because of longer average schooling and earlier retirement.

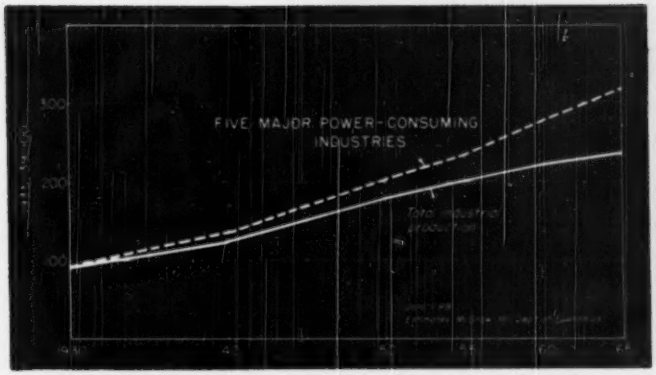
However, as the labor force increases, the length of the work week will almost surely be cut, just as it has been during the past two decades. The great rise in national output will come not from more manhours but from higher output per manhour worked.

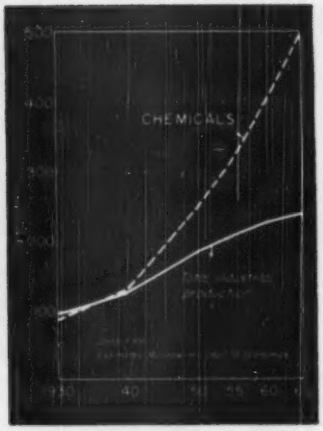
Productivity . . . Rising productivity is the second great force working to increase the total national product. Business is still discovering new machines and new methods which mutiply the amount of electric power per worker, and help turn out more goods in less time. And with the continuing enlargement of industrial research programs, the rate of discovery may well be more rapid in the next 15 years than in the past.

It is extremely difficult to tell how much money will actually be invested to improve plants and equipment, or how well workers will match the improvement in equipment by their own efforts. It will depend very largely on what sort of incentives there are for investment and for extra diligence on the job. High taxes work against a great rise in capital expenditures. But high wage costs should encourage business to invest at least as much in new tools as in recent years. If labor relations are handled with sufficient skill, there may also be an increase in worker interest. But postwar experience suggests that this cannot be counted on.

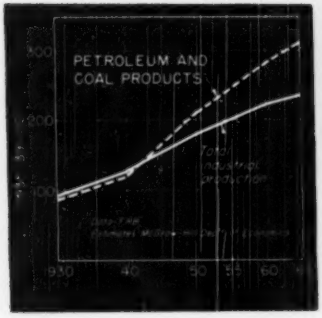
If output per manhour does rise about 1.7% yearly, and if the labor force increases about 4½ million as expected, total national production will rise from $258 billion in 1950 to $335 billion in 1965, despite the shorter work week. This will mean a rise in the Federal Reserve index of industrial production (1935-39=100) from about 180 in 1950 to 238 in 1965. And there will be a corresponding gain in the trade and service industries.

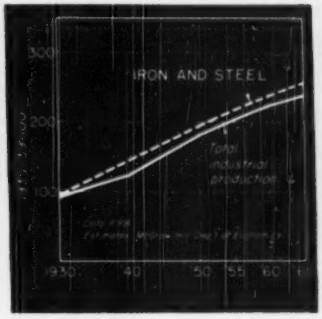
* The forecast assumes that there will be no war and that the specific years shown on all charts will be years of close to full employment. All forecasts are in 1950 prices which do not reflect the possibility of inflation. Prepared by McGraw-Hill Dept. of Economics.

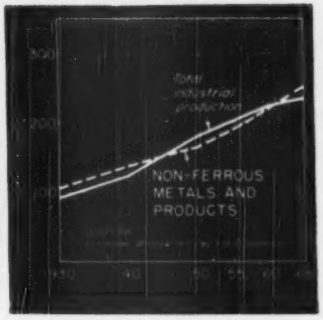


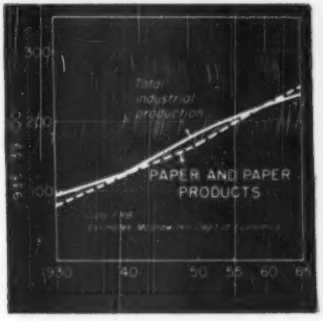


PRODUCTION WILL RISE fastest in those industries where power is used most







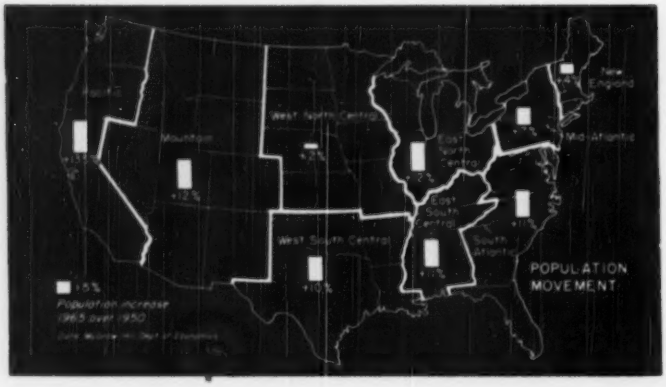


Growth in Major Power Consuming Industries

THE INDUSTRIES which are the largest users of electric power have particularly bright growth prospects. Production in the five major power consuming industries—steel, paper, non-ferrous metals, chemicals, and petroleum and coal products—is estimated 17% higher in 1955 than in 1950. By 1960, the group should show a gain of 38%, and by 1965, 57%, well ahead of the estimated growth in total industrial production.

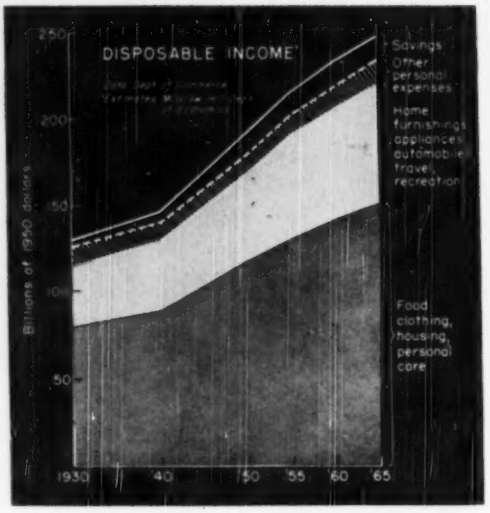
The next decade promises remarkable progress in the chemical field. Many scientists believe that we are at the beginning of a "chemical century." At any rate, the chemical industry shows every sign of continuing to spawn new products and processes requiring large amounts of electric power. Chemical developments will also be important to the oil industry which expects a substantial rise both in output of "petrochemicals" and of the usual refinery products.

Production of iron and steel, paper, and non-ferrous metals, will probably move up about in line with the overall index of industrial production. Except for the new light metals, none of these fields appear to have unusual growth in store. But the bright outlook for petroleum and chemical products ensures that the heavy power users will continue to advance faster than the rest of industry.



POPULATION will continue moving south and west, West North Central gaining little

HIGHER PERSONAL INCOME will bring a great rise in consumer spending



Consumer Markets

POPULATION GROWTH will greatly expand the markets for consumer goods and services. But this expansion will be more noticeable in some areas than in others. At present, the center of U. S. population is moving southwest. And there's no reason to expect the trend to reverse.

Population Shifts . . . Of course, population shifts may be accelerated by decentralization of industries—either for defense purposes or because of technological change. The concentration of heavy industry in the Great Lakes region, for example, still anchors much of the population there, despite the general march southward and westward. On the other hand, migration between states could conceivably be slowed down by inability of some areas to absorb more people without congestion. But present trends indicate the following pattern for population growth:

In the New England and Middle Atlantic States, population density is already very high. Only a moderate population increase can be expected by 1965.

The Southeast, East North Central and Mountain states are growing at about the national average rate. They'll have 10% to 12% more people by 1965.

The West North Central region is being largely bypassed by industrial development and will show little gain in population.

The really big population increase will come in the Far West. The Pacific Coast will have about 13% more inhabitants in 1965 than in 1950. Industrial workers and pleasure seekers are still treking in this direction.

These changes in the importance of regional markets will mean corresponding shifts in the location of industries, particularly consumer goods industries.

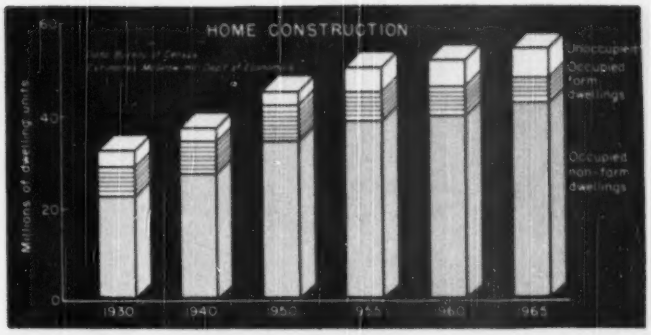
Consumer Expenditures . . . Which products will the expanded American market demand in greatest quantities? Will people spend as much as now on necessities, like food and clothing? Or will the share of income being spent on pleasures and conveniences increase?

Most of consumer income will still go for necessities. The great surge of population and income from 1940 to 1950 didn't change the importance of these items.

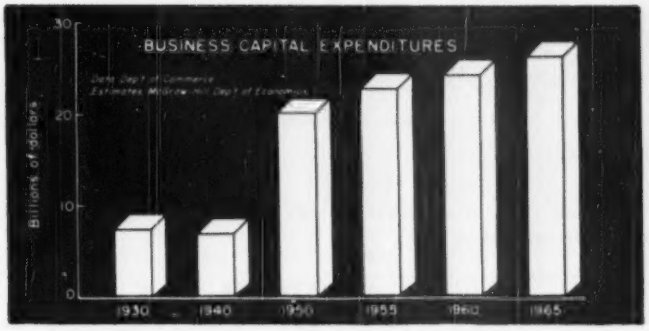
Needs for basic items are probably less expansible now than in the 1930's, when many families clearly had a substandard existence. Moreover, shorter working hours and more leisure should create more demand for pleasure items. For these reasons, the amount spent for things like automobiles or electric blankets, may be greater than shown on the chart above, which projects expenditures for different categories of consumer goods according to the proportion of income spent on each in the past.

If disposable income rises to the level forecast, expenditures on electric appliances, for example, may be as much as $6 billion by 1960 and $6.5 billion by 1965, compared with about $5 billion in 1950. Total expenditures for optional consumer goods and services may well be a third higher in 1965 than at present.

NUMBER OF HOMES will rise gradually in line with lessened rate of family formation



INVESTMENT IN PLANT and equipment will continue much higher than in past decades to employ a growing labor force



Construction

NEW HOUSING . . . Population growth will be felt most directly in the housing field. The total number of occupied dwelling units in 1965 should be at least 5 million greater than in 1950. The number of occupied non-farm units will be up even more, probably almost 7 million. This will be slightly offset by migration from farms which may vacate a million farm homes during the period.

These figures are large, but they don't indicate a continuation of the 1949-50 housing spree. Two special factors which helped the immediate postwar housing boom won't be present in the 1950's: (1) Undoubling of families crowded by the wartime shortage. Most of these now have their own homes. (2) The recent high rate of family formation can't be expected to keep up.

About 3½ million new households are likely to be formed in 1950-60, compared with 8 million in 1940-1950. That's why the number of occupied dwelling units is scheduled to go up less than 3 million, although it rose 7½ million in 1940-50. The big population increase in the '50's will consist of babies and oldsters, not people of marriageable age. There just weren't enough children born in the '30's to be married in the '50's. So fewer new families will be formed. And with fewer existing families living doubled up, there'll be less total need for new housing.

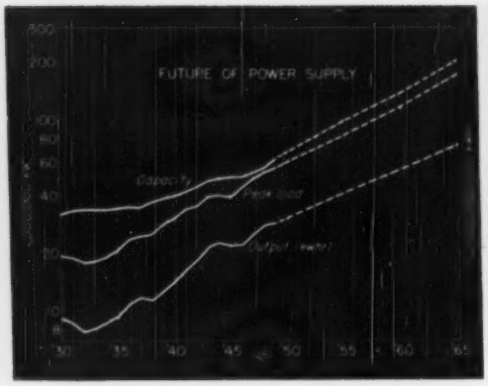
In the 1960's, housing needs will rise again. By then, the postwar baby crop will be full grown and ready to form new families. The number of occupied units is expected to jump 2 million in 1960-65, compared with 1 million in the 5 years from 1955 to 1960.

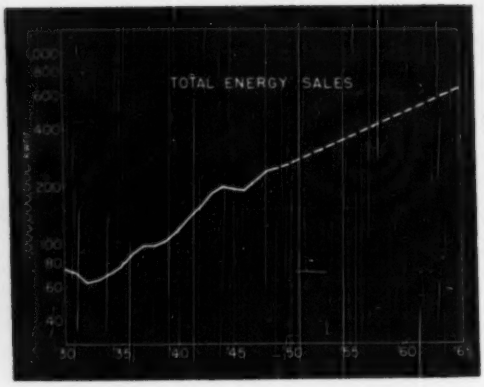
The total number of homes, particularly non-farm homes, which are built will exceed the growth in occupied units. The vacancy ratio will probably approach 10% before new homebuilding slows down much. There may also be a sizable boom in replacement housing.

The houses built in 1950-65 are likely to be somewhat bigger and better equipped than those built since the war. Families will be bigger, and people will have more leisure. So they will put a good share of their increased incomes into improved housing and home-furnishings.

Business Plant and Equipment . . . Business outlays for new plant and equipment will average probably higher in 1950-65 than in the past few years. But the economy will need larger amounts of capital equipment to employ the growing labor force and to supply consumer goods for a higher standard of living. Moreover, the rising trend of wages makes continued modernization of plant and equipment a necessity in order to hold down costs.

For these reasons, investment in capital goods may well be slightly higher by 1955 than in 1950. By 1965, it may be almost a third higher than this year. About one-third of the investment is likely to be in new plants, and about two-thirds in new equipment. Because of the growth in demand for their products (p 101) chemical process industries will probably have the heaviest investment programs.





LOAD AND CAPACITIES RISE RAPIDLY

	Sales (Billion Kwhr)	Losses %	Output (Billion Kwhr)	L.F. %	Non-Coincident Peak (Million Kw)	Reserve % of Peak	Capacity (Million Kw)
1949.....	248.5	14.6	291.0	58.8	56.5	11	62.7
1950.....	265.8	15	312.7	58	61.5	12.5	69.2
1955.....	356.6	15	419.5	56	85.7	18	101.1
1960.....	480.6	15	565.4	54	119.5	18	141.0
1965.....	645.3	15	759.2	52	166.7	18	196.7

ENERGY SALES INCREASE TO NEARLY 650 BILLION KWHR

	Residential and Farm (Billion Kwhr)	Small Light and Power (Billion Kwhr)	Large Light and Power (Billion Kwhr)	Miscellaneous (Billion Kwhr)	Total Sales (Billion Kwhr)
1949....	65.5	46.3	120.8	15.9	248.5
1950....	78.5	49.9	126.8	16.6	265.8
1955....	104.4	69.4	161.8	21.0	356.6
1960....	152.6	96.5	206.5	25.0	480.6
1965....	218.5	133.3	263.5	30.0	645.3

BLUEPRINTING THE FUTURE

Load Will Triple in 15 Years

This is the prospect towards which the power industry must look in the not too distant future. Projections to 1955, 1960 and 1965 indicate tremendous growth

IN 1965 the electricity generating capacity of this nation should approach 200 million kw, producing over 750 billion kwhr for an energy sale of around 650 billion kwhr, at a revenue of over $10 billion. Today, the capacity is, roughly, 63 million kw, the output 291 billion kwhr, the sale 250 million kwhr, and the revenue $4.6 billion.

This estimate for 1965 assumes that sales of electricity will grow at a somewhat slower rate than in the past 23 years for which competent data are available.

The projections of numbers of customers, energy sales, revenues, outputs, peak loads and generating capacities detailed in the following pages are a sort of three-legged stool. One leg is the growth of population as estimated by the McGraw-Hill Department of Economics. The second is the statistical record of the industry. The third is appreciation of the potentialities of electricity utilization in the home, on the farm, in commerce, and in industry.

New uses of electricity such as house heating, the heat pump, television, the clothes dryer and high-frequency heating, will require significant increases in generating capacity and in general system facilities in the next 15 years. And the possibility of other, now unknown, new uses appearing at any time cannot be ruled out.

To the effect of these new things on the growth of the industry, there is to be added that from the accelerated spreading out of uses already firmly established in homes, farms, factories, stores and offices.

Farther along in this article are tables of projections of energy sales to the various customer groups. These projections are the bases for all other estimates presented here.

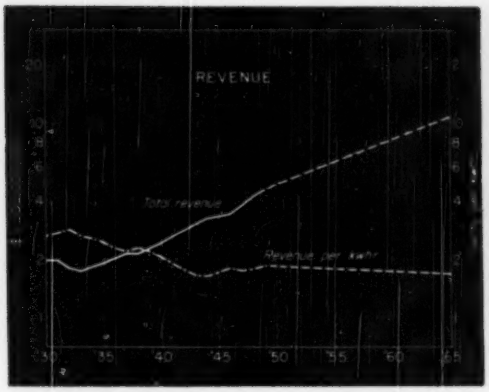
In residential and farm service, average annual energy usage per customer is projected from 1,809 kwhr in 1949 to 4,792 in 1965.

Saturation of television receivers is now about 10%. It is assumed that the saturation in 1965 will be 90%. This means that in that year television at unit usage of

CUSTOMERS RISE WITH POPULATION GROWTH

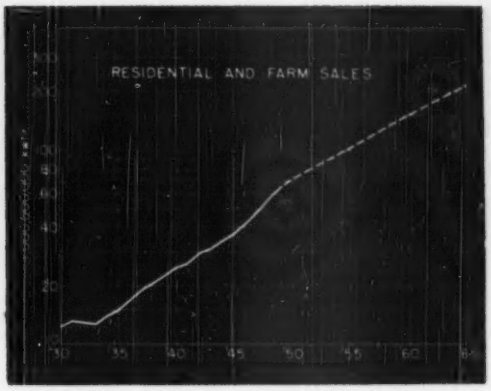
	(Average of Year—1000) Residential and Farm	Small Light and Power	Other	Total	Population
1949.....	36,212 (4.14)*	5,212 (28.8)*	363	41,787	150,000
1950.....	37,785 (4.01)	5,325 (28.4)	380	43,490	151,500
1955.....	40,500 (3.88)	5,997 (26.5)	400	46,827	157,000
1960.....	42,800 (3.81)	6,596 (24.7)	420	49,816	163,000
1965.....	45,600 (3.71)	7,341 (23.0)	440	53,381	169,000

* Population per customer



STABILITY OF UNIT REVENUE IS INDICATED

	(Million $)				
	Residential and Farm	Small Light and Power	Large Light and Power	Miscellaneous	Total Revenue
1949	1,877	1,229	1,262	245	4,614
1950	2,030	1,297	1,331	257	4,915
1955	2,714	1,735	1,618	338	6,405
1960	3,586	2,316	2,065	418	8,385
1965	4,589	3,066	2,635	521	10,811



LARGEST INCREASE IN RESIDENTIAL AND FARM SERVICE

	Customers (Average for Year)	Sales per Customer (Kwhr per Year)	Total R & F Sales (Billion Kwhr)
1949	36,212,000	1,809	65.5
1950	37,785,000	1,919	72.5
1955	40,500,000	2,579	104.4
1960	42,800,000	3,566	152.6
1965	45,600,000	4,792	218.5

200 kwhr per year will be contributing 180 kwhr to average annual use. The electric clothes dryer has a present saturation of less than 0.5%. It is estimated to use over 700 kwhr per year. Say its saturation has risen to 40% in 1965. The dryer's contribution to 1965 average annual use thus amounts to 280 kwhr. The average electrically-heated home (resistance heating) probably uses 15,000 kwhr per year for that purpose. Assume a saturation of only 2% in 1965 and the contribution of house heating to average annual use in 1965 becomes 300 kwhr. The total of the 3 new uses in 1965 is 760 kwhr.

Now let us consider a couple of the established uses of electricity in the home—the range and the water heater.

Over a million electric ranges were sold in 1949, 1.6 million in 1948. Surely the manufacturers of them will put every effort into maintaining sale of this appliance at the present level, into pushing it higher if they can. Suppose the saturation is raised from the present 18% to 40% in 1965. At 1,100 kwhr per year per range, this appliance will put 440 kwhr into the 1965 average annual usage. The water heater has a present saturation of about 10%. If its sale is held at the 1949 level of around 700,000, the saturation in 1965 will be about 30% and at 3,600 kwhr per heater per year its contribution to average annual usage will be 1,080 kwhr. The total of these two uses in the 1965 average is 1,520 kwhr.

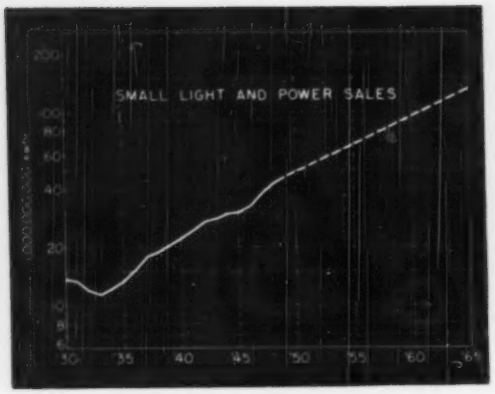
As the years have passed the proportion of lighting in home and farm use of electricity has steadily declined. This does not mean that the amount of energy used for lighting has decreased. On the contrary it has steadily increased, as is attested by the continually growing volume of lamp sales. No accurate data are available, but a reasonable estimate puts lighting at about 450 kwhr in the 1949 average annual usage of residential and farm customers. Assume the figure has risen to 700 kwhr in 1965.

With the 3 new uses—house heating, television, and the clothes dryer—and the 3 established uses—the range, the water heater and lighting—we have totalled up 2,980 kwhr in the 1965 estimate of 4,792 kwhr average usage.

In a typical list of electricity uses in the home appear about 30 items exclusive of the 6 considered in the foregoing. Uses of electricity on the farm number over 100. They include several that are now or may become important contributors to the 1965 average—the refrigerator, the food freezer, air conditioning, the automatic washer, crop drying, to name a few. The sum of their energy requirement and the 2,980 kwhr above will more than top the 4,792 figure.

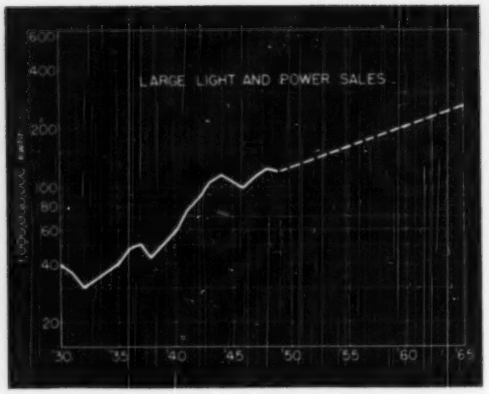
Competition in their many lines of business will cause commercial customers to use increasing amounts of electricity for lighting and air conditioning as means for attracting buyers. The NEMA survey made in Indianapolis in 1949 showed that 85% of stores are inadequately lighted. There are a million classrooms in the schools of the nation that can use 7 times the light they now have. The possibilities of increase in commercial cooking are limited only by the amount of sales effort put on it. These considerations give credibility to the estimate of some 18,000 kwhr as the 1965 figure of average annual energy sale per small light and power customer.

In industry the pressure of higher and higher wage scales and of increased material costs all along the line will practically force a growing utilization of electricity. Materials handling, automatization of production operations, and employment of high-frequency and other electric heat, demanding more and more electricity, are certain to increase. It is impossible to state these developments in any quantitative fashion, but the 5% annual increase in electricity sales to large light and power cus-



SMALL LIGHT AND POWER SALES INCREASE 200%

	Customers (Average for Year)	Sales Per Customer (Kwhr per Year)	Total SL & P Sales (Billion Kwhr)
1949	5,212,000	8,876	46.3
1950	5,325,000	9,364	49.9
1955	5,927,000	11,705	69.4
1960	6,596,000	14,631	96.5
1965	7,341,000	18,289	133.3



LARGE LIGHT AND POWER SALES MORE THAN DOUBLED

	Billion Kwhr	1935-1939 Index	IP Index
1949	120.8	257	176
1950	126.8	270	180
1955	161.8	343	202
1960	206.5	439	222
1965	263.5	561	238

tomers seems not unreasonable over the next 15 years.

Load and Capacities . . . Data for 1949 in this table are actual. Losses, load factors, and reserves for future years are assumed on the basis of present judgment.

The capacities tabulated show an increase of about 200% in the next 15 years. This compares with the recent trend of load growth which has doubled about every 11 years. One reason for this rapid future growth of capacity is the assumption of gradual decline in load factor from 58.8% in 1949 to 52% in 1965. And reserve margin is raised from 11% of peak in 1949 to 18% of peak in 1965.

Energy Sales . . . A check against the validity of these estimates is afforded by comparison of total sales in the table with projections of total sales made by applying average rate of increase over the 23-year period, 1926-1949. This rate is 6.69% per year, 38.2% per 5 years. On this rate, total sales for 1950 are 265.1; for 1955, 366.4; for 1960, 506.2; for 1965, 699.6.

Customers . . . Figures of residential and farm, and of small light and power, customers were arrived at by relating them to population and family formation. These factors are discussed in the section on sales of customer groups. Included in the "Other" column of the customer table are large light and power, street lighting, transportation, public authorities, and interdepartmental, as designated in data published by the Edison Electric Institute.

Revenues . . . As a check on these projections, it is interesting to note that the 1965 revenue would be just under $12 billion if it were assumed to increase at the same rate as during the 12 years, 1937-1949. Of course this period included substantial rate reductions which may not be duplicated in the next 15 years.

Residential and Farm Service . . . The limiting factor on the number of residential and farm customers is the number of farm and non-farm households in the nation. These have been estimated by the McGraw-Hill Department of Economics: (in millions) 1950–52, 1955–45.5, 1960–46.5 and 1965–48.5.

Because of group metering in multiple dwelling units, the number of residential and farm customers will always be less than the number of households. But the difference between them will continue for some years to become smaller, as in time past, as connections are made to previously unserved dwellings. This condition is shown by the progressively smaller ratios between population and customers. In 1927 the ratio was 6.77 and in 1949 was 4.07. Except in deviations in the depression '30's and in the war years the curve of decline of the ratio is fairly smooth. Its shape indicates quite definitely that it will flatten out in not too many years.

Considering the relationship between customers and households and the shape of the ratio curve, the figures of customers in the table were arrived at. They indicate a decline in ratio of population to customers from 4.07 in 1949 to 3.71 in 1965 and an increase in customers against households from 88% in 1950 to 94% in 1965.

Sales per customer were projected from 1,809 in 1949 on the rate of increase of the 12 years from 1937—6.09% per year, 34.4% per 5 years. Total sales were then obtained by multiplying by numbers of customers.

Small Light and Power Sales . . . Customers are projected from 5,212,000 in 1949 on the rate of increase from 1927. Increase rate from 1937 was also calculated

and found to be slightly higher than for the longer term, which was taken as more conservative. It is 2.16% per year, 11.3% per 5 years.

Rate of increase based on the statistical record was taken for projection of these customers because it was felt that growth in number of service and comparatively small production establishments resulting from changes in living habits would more than compensate for any trend of decrease in number of retail stores, as caused, for instance, by super-markets.

The long-term rate of increase, 1927 to 1949, was taken from projection of sales per customer as more conservative than the short-term, 1938-1949, rate. The latter is 7.2% per year, 42.1% per 5 years. The rate used is 4.59% per year, 25.16% per 5 years. It is reasonable to take the slower rate because, under the conditions assumed for this look ahead, conditions are favorable for the establishment of smaller service and other commercial enterprises and these will use correspondingly smaller amounts of electricity. Total SL&P energy sales during the period were obtained by multiplying the energy sales per customer by numbers of customers.

Large Light and Power Sales . . . Sales were projected from 120.766 billion kwhr in 1949 at the rate of 5% per year, 27.6% per 5 years.

Because of short-term fluctuations in industrial activity, it is impracticable to derive any average rates of sales increase that will result in figures for any one future year that can be accepted as near to accuracy. Also the change in number of customers to any future year is quite indeterminable. For these reasons the projections were made on total sales.

The 5% increase rate is more than that of the decade, 1930-1940, and is less that of the decade, 1939-1949. Also it is less than that for the 19-year period, 1930-1949. Considering the tremendous surge of industrial development in the war years and the probability of a shorter work week in the future, it is not likely that the rate of increase of industrial use of electricity of the past two decades will be maintained. At that, the rate taken results in future large light and power sales far outstripping the index of industrial production as estimated by the McGraw-Hill Department of Economics. This indicates what is reasonably to be expected—a rapidly widening application of electricity to industrial operations.

Miscellaneous Energy Sales . . . Street lighting and public authorities are predicted to have substantial growth with transportation remaining constant. An increase of 200% in street lighting and 150% in public authorities seems to be very reasonable, giving a total of 100% gain for the group.

MISCELLANEOUS ENERGY SALES RISE MORE SLOWLY

	Street Lighting	Public Authorities (Billion Kwhr)	Transportation	Interdepartmental	Total
1949	2.7	6.5	6.1	0.6	16.0
1950	3.0	7.0	6.0	0.6	16.6
1955	4.5	9.5	6.0	1.0	21.0
1960	6.0	12.0	6.0	1.0	25.0
1965	8.0	15.0	6.0	1.0	30.0

RESIDENTIAL AND FARM REVENUE

	Sales (Billion Kwhr)	Revenue per Kwhr, ¢	Revenue (Million $)
1949	65.5	2.86	1,877
1950	72.5	2.8	2,030
1955	104.4	2.6	2,714
1960	152.6	2.35	3,586
1965	218.5	2.1	4,589

Note: These figures show the bill for electricity used in homes and on farms rising from its present ratio of about 1% of disposable income to 1.85% in 1965.

SMALL LIGHT AND POWER REVENUE

	Sales (Billion Kwhr)	Revenue per Kwhr, ¢	Revenue (Million $)
1949	46.3	2.66	1,220
1950	49.9	2.6	1,297
1955	69.4	2.5	1,735
1960	96.5	2.4	2,316
1965	133.3	2.3	3,066

LARGE LIGHT AND POWER REVENUE

	Sales (Billion Kwhr)	Revenue per Kwhr, ¢	Revenue (Million $)
1949	120.8	1.05	1,263
1950	126.8	1.05	1,331
1955	161.8	1.0	1,618
1960	206.5	1.0	2,065
1965	263.5	1.0	2,635

MISCELLANEOUS REVENUE

	Sales (Billion Kwhr)	Revenue* per Kwhr, ¢	Revenue (Million $)
1949	16	1.53	245
1950	16.6	1.54	257
1955	22	1.53	338
1960	25	1.67	418
1965	30	1.74	521

* Higher unit revenues caused by increasing proportion of higher rate business included in "Miscellaneous" in later years.

Sales and Revenues . . . Unit revenues for future years, used in the series of revenue tables, are based on examination of trends for the various customer classes as they appear in the statistical record. A floor under them is indicated by data in "ELECTRICAL WORLD's 5th Steam Station Cost Survey," published in 1947, which states a bus-bar cost averaging 7.5 mills per kwhr. The 6th Survey, which appeared April 24, last, says that, despite much higher post-war construction and operating costs, the power companies have been able to hold the unit bus-bar cost for new plants to about the same level. Thus it does not seem probable that the future average revenue per kwhr will go much below 1¢ for any class of service, such as industrial. This means that for service, such as residential, in which much higher distribution cost is incurred, the unit revenue must be on the order of 2¢ minimum.

These revenue assumptions are in 1950 dollars. The figures are thus lower than they probably will be in future years.

Government and Cooperative Power Is Shooting Up

ELECTRICITY SUPPLY from government sources—federal, state, municipal and other—and from REA cooperatives stands today as 20% of the industry in terms of generating capacity, 19.7% in terms of energy production, and 18.9% in terms of customers, according to data of the Federal Power Commission. Supply from these sources is now 6 times its 1930 size in capacity, 11 times in production, and 3 times in customers. Since the future growth of this segment of the electricity supply industry is dependent almost entirely on political developments, it is impossible to make any firm projections of its increase in the 15 years to 1965, which is the period covered in the look ahead of other articles in this issue of ELECTRICAL WORLD.

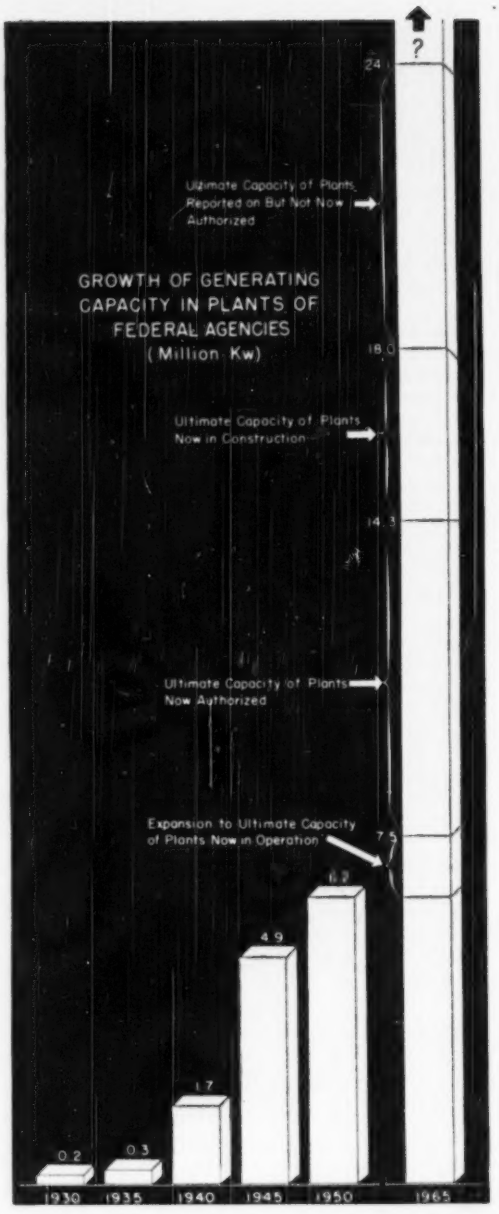
There are three factors contributing to the increase of this segment of the industry. One is normal growth of load which requires continual additions to capacity of any existing electricity supply system. Effect of this factor is probably most apparent in the growth of municipal utilities. The second is river development as the principal element of growth of federal agencies in the field of electric power. Third is take-over of investor-owned systems or parts of them, particularly as exemplified by state projects and power districts in Nebraska and the Pacific Northwest.

I—Federal Agencies

From small beginnings in 1930—0.2 million kw in plants built and operated by the Bureau of Reclamation in connection with irrigation projects, and by the National Park Service—the share of federal agencies in the electricity supply capacity of the nation has, to now, been multiplied 31 times. An incomplete compilation of ultimate capacities of plants in operation, in construction, authorized and reported on again multiplies the federal agencies' share 4 times over 1950. Thus, at some time in the future, probably before 1965, the share may well have been multiplied over 120 times over 1930.

1949 Generating Capacity

At the end of 1949, (the 1950 bar on the accompanying graph) generating capacity of federal agencies was 6.2 million kw or about one tenth of the national total according to Federal Power Commission data. The 1965 bar is raised to 24.1 million kw by adding to the 1950 capacity in operation, figures for future construction. These figures are from the Bureau of Reclamation and from the Corps of Engineers. They cover expansion of present plants to ultimate capacity and ultimate capacity of plants in construction, authorized, and reported but not now authorized. The bar does not include any future capacity additions that may be planned by the Tennessee Valley Authority nor any in projects now being promoted, as on the St. Lawrence and in New England. Neither does it



include any steam generation that may be provided to firm up water power outputs. It is thus to be expected that the top figure of 24.1 million kw in 1965 will be greatly exceeded unless there occurs a major change in political climate affecting federal invasion of the electricity supply field.

On a map showing the power project responsibilities of the Department of Interior, dated February 1, 1950, and for which space is not available here, are located and listed 140 federal plants in operation, in construction and authorized. They total over 16 million kw in ultimate capacity and are situated in 30 states, plus one in Alaska. Completion years of these plants are from 1950 to 1960 for capacity in construction or initially planned, over 80% of them scheduled before 1956. This map does not include any TVA plants; it covers only Corps of Engineers and Reclamation undertakings.

The map shows four areas of major concentration of power projects. One is in the northwestern states of Washington, Oregon, Idaho, Montana, Wyoming, North and South Dakota and extends down into Colorado. The second is in California, Nevada and Arizona. The third is in the middle-south states of Missouri, Oklahoma and Arkansas, extending into Texas. The fourth is in the southeastern region including Kentucky, Tennessee, West Virginia, Virginia, North and South Carolina, Georgia and Alabama.

Energy Production of Federal Agencies

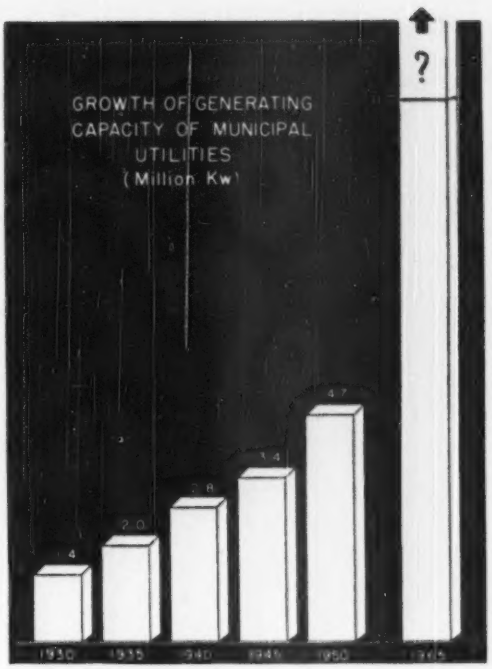
Energy production in all plants of federal agencies in 1949 amounted to 38.1 billion kwhr; about one-eighth of the national total. This was over 80 times the 465 million kwhr output of 1930. Production in 1949 was at the rate of 6,140 kwhr per kw of generating capacity. This is an extraordinarily high rate, much higher than has ever been attained by the national average of water power. It is accounted for by the facts that a considerable amount of energy from federal agency plants goes into metal reduction and chemical processes which use large quantities of electricity, and that the power shortage in the Columbia River region still continues.

In another article, "Load Will Triple in 15 Years," in this issue it is estimated that in 1965 202.6 kw in generation will produce 742.1 billion kwhr, a rate of 3,663 kwhr per kw. Over the past 14 years water power averaged an energy production rate about 17% higher than that for fuel and hydro combined. This indicates a water power rate in 1965 of about 4,300 kwhr per kw. At this rate the 24.1 million kw of federal agency capacity will produce some 104 billion kwhr in 1965, nearly one-seventh the national total.

Customers Served by Federal Agencies

In terms of customers directly served, federal power agencies do not figure largely in industry statistics. In 1947, according to the Federal Power Commission (later data not available), customers of these agencies numbered only 12,691, about a third of one percent of the national total. Since the general policy is that federal agencies are primarily producers and wholesalers of electricity, selling to local distributors, it is not likely that this proportion will increase in future years.

Proportionate to the totals of generating capacity and



of energy production in government and cooperative plants, federal agencies were 50% and 60% respectively in 1949. In 1930 the proportions were 11% and 10%. These comparative percentages show how in 20 years the federal government has changed from what might be termed the role of casual participant to become the dominating actor on the stage of non-investor-owned power. And from the data here presented it appears that such domination of the scene will become greater as time goes on.

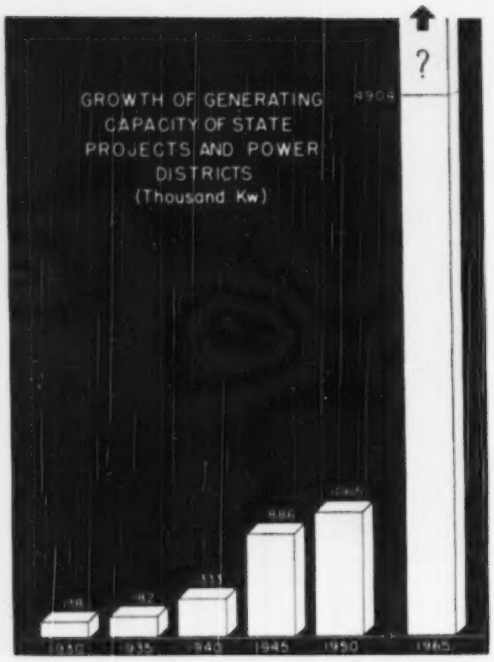
II—Municipal Systems

Projecting generating capacity of municipal systems on its rate of growth in the past 20 years results in a figure of 10.5 million kw in 1965, as shown on the accompanying graph. It may be very much too high or, conversely, very much too low, depending principally on growth.

Capacity increases of federal agencies, as indicated earlier in this article, would operate to reduce the need for future additions to capacity in municipal plants if city officials were inclined that way, as many are. But there seems to be a growing disposition on the part of some local governments to look distrustfully at federal power developments. Another possibility, which appears remote at present, is that cities now served by investor-owned companies may feel it to their advantage to join the ranks of public power.

Production by Municipal Plants

Production of energy in municipal plants rose from 3.5 billion kwhr in 1930 to 13.4 billion in 1949, while capacity increased from 1.4 million to 4.7 million kw.



These figures show a rise in annual kwhr per kw from 2,500 to 2,850 as compared with 2,882 in 1930 and 4,883 in 1949 for the entire industry. This difference in use of generating capacity is largely accounted for by the fact that plants of municipal systems are generally small and are not interconnected.

According to the Federal Power Commission 4,588,000 customers were served by municipal systems at the end of 1949. In 1932, 15 years earlier, the number was 2,228,000. The increase in the period was about 100%. Over the same years the increase for the whole industry was around 50%. The much more rapid gain of the municipal systems was caused by the take-over of power companies in the Tennessee Valley area and in Nebraska.

III—State Projects and Power Districts

Grouped under this head are the state and county power authorities such as the Nebraska and South Carolina public power systems, the Crisp County Power Commission in Georgia, and the numerous public utility districts of the Northwest. Their totals in generating capacity, energy production and customers are not impressive in comparison with the whole electricity supply industry, but their growth has been rapid in the past 20 years. Also it is significant that their growth is almost entirely the result of take-over of power company systems or parts of them. For this reason no estimate of their individual future growths can be made. They are included in the total picture of the industry elsewhere in this issue.

In 1930 energy production of these systems was 518 million kwhr, 5.6 billion in 1949, an increase of about 1,000%. In generating capacity the increase was from 154,000 kw to 1,040,000, 575%. No 1930 figures on customers are available, but in 1947 the number was 406,857, about one percent of the national total.

IV—REA Cooperatives

Data provided by REA and published in succeeding statistical issues of ELECTRICAL WORLD from 1942 on show the following picture:

Growth of Cooperative Systems

	Systems	Plants	Ratio, % Plants/Systems	Capacity, Kw
1941.....	773	48	6.2	18,287
1942.....	803	60	7.5	32,843
1943.....	811	65	8.0	73,200
1944.....	826	65	7.9	76,500
1945.....	848	75	8.8	95,846
1946.....	869	79	9.1	114,678
1947.....	911	81	8.9	184,050
1948.....	952	96	10.0	252,868
1949*.....	993	94	9.5	335,000

*Estimated.

The ratios of number of generating plants to number of systems show a general rise over the 8-year period, 1941-'49, from 6.2 to 9.5%. This increase and that of capacity of plants from 18,287 kw in 1941 to 335,000 kw in 1945 spring from three causes. One is the infrequent real need for local generation at places where connections to existing systems are impracticable. The second is growth of load. The third is the apparent disposition of REA officials to regard cooperative systems generally as competitors, instead of associates, in the business of electricity supply.

REA-Financed Generation

This third factor is to be seen plainly in a list (not reproduced here) of "REA-Financed Generation and Transmission Federations as of April 6, 1950," itemizing loans, capacities, numbers of plants, miles of line, and numbers of distribution cooperatives included. Of the 27 federations, 2 are for transmission only and information on 2 others is indefinite. The remaining 23 add up to a total of 76 plants of which 42 are diesel, 19 are steam, and 15 are hydro. Of the 76 plants 53 are now in operation. They total 323,100 kw. The other 23 are in construction or loans have been allocated for them. They total 257,300 kw.

No projection has been made of future growth of capacity in REA-financed systems. Decisions on some of the projects for which loans have been allocated have not yet been made by state and national authorities. But we do know that load growth on REA systems will require additional capacity which will be provided in some manner.

Estimate of customers on cooperative systems was 3,044,000 at the end of 1949. Of these, 2,344,000 are farms, the remaining 700,000 are other rural dwellers and business places. Since very few farms remain to be connected it is not likely that cooperative customers will increase significantly in the future, except by possible takeover of parts of existing systems.

National Power Supply

National outlook calls for continued expansion of generating capabilities. Thermal facilities using solid fuel will predominate. Large scale hydraulic installations will continue but must be coordinated with thermal facilities for maximum benefits

WALKER L. CISLER
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THE CONTRIBUTION that the electric power industry has made to the social and economic well-being of our country has been great. It will be even more so if we act on our vast background of experience and make plans for the future. The responsibility which the industry has, as an important part of our American industrial system, in fostering the continuing and increasing strength of our nation is large. We must be continually aware of this. It is extremely important that electric power systems prepare development plans for the foreseeable years ahead and essential, too, to make them known. The future of electricity supply as a business of individual enterprise rests upon taking an aggressive and courageous attitude of service to the public by all of us in the industry.

Some important factors we must consider in looking into the future follow. These are the personal opinions of the writer and are given for whatever helpful purpose they may serve.

Energy Sources . . . The main sources of energy for power generation are, and will continue to be, the heat released by the burning of gaseous, liquid, and solid fuels, and falling water. It should be clearly understood that about three-fourths of the electricity produced in this country comes from fuels and only one-fourth from hydraulic power. This ratio will likely remain much the same. The development of large hydraulic projects will undoubtedly continue. It is important that these be fully coordinated and integrated with the thermal sources. The requirement of better economic and physical balance between thermal and hydraulic generation becomes increasingly important if the greatest over-all benefit to the country is to be achieved. The fuel resources of the country are extensive and, for purposes of power generation, far outweigh the hydraulic resources. Water supply, irrigation, and flood control have first claim in the development of water resources. Consequently, the fuel reserves of the country are the long-continuing reserves for power. Any other source is auxiliary to and not predominating over the efficient and economical use of fuels for the social, economic and political stability of the country.

"What part will the heat energy released by nuclear fission have in the development and expansion of electric power generation over the next fifteen years?" This question deserves more space than is available here. It should, however, be said that in the light of known progress and development in this most important new field, the use of nuclear heat power reactors will not be possible on any commercial scale in the near future. Existing and new installations using present heat sources will have served out their economic lives long before substantial use of atomic energy arrives. Careful analysis will show that the capital cost involved in utilizing atomic fuel may be so great as to make its use economically unsound even if the cost of the fuel should be a minimum. That part of the investment in a thermal electric power system required for the delivery of heat units to the prime mover throttle may vary from 20 to 25%. The problems involved in the preparation, handling, utilization, and disposal of atomic fuel are great. Unless they can be solved at lower capital costs than presently seems possible, there can be no

THE FUTURE OF ELECTRICITY PRODUCTION

1. Present fuels will continue as the major source of energy because water power is limited and practical application of atomic fission is far ahead.
2. Loads on generating plants are increasing and are lasting longer.
3. Difference between summer and winter loads is decreasing.
4. Coordination between systems may allow reserve margin as low as 15%.
5. Continuing improvement in thermal efficiency is expected.
6. Manufacturing capacities for production of necessary equipment will be ample.

early substitution by this new-found fuel for coal, oil and gas, or even any supplemental use of it. Consequently, development plans should continue unhesitatingly to utilize the present sources of energy.

Load Requirements . . . The 1950 peak loads on the interconnected systems of the country are estimated to be about 58½ million kw. The difference between summer and winter loads tends to become less. This requires additions to generating capabilities to provide for off-peak maintenance outages. Loads are getting to be of longer duration, requiring more sustained equipment operation.

Generating Capabilities . . . The United States has by far the largest interconnected generating capabilities in the world. Our systems are one of our greatest sources of strength for peace and national defense. In 1950 it is estimated that the interconnected systems will have a total capability of more than 67½ million kw, in 1951 in excess of 74 million, in 1952 of 78¾ million and in 1953 of nearly 83 million, all based upon median water conditions. This does not take into account the capabilities of industrial, transportation and other systems, adding 13 to 15 millions. It is apparent, therefore, that capabilities are being added too rapidly and by 1955 may exceed 100 million kw. These capabilities are generally in excess of the rated capacities and are firm, sound, and the result of improvements in operation, maintenance, and coordination.

Those areas which are predominately hydraulic require additions to take care of adverse water years either in the form of more hydro, or thermal capabilities.

Reserve Margins . . . During the postwar period, reserve margins have been lower than what would be considered safe for both peace and defense requirements. Unprecedented load growth, coupled with the time required to manufacture heavy power equipment after federal wartime restrictions were removed, created low reserve situations in many parts of the country.

Beginning in 1949 a reversal took place and reserve margins are rapidly increasing to the point where they may be considered safe except in the two predominately hydro areas. The most recent data available show for 1950 a reserve margin of almost 16% for the country as a whole. This will vary between power regions, two of which will require a longer time to restore adequate reserves. It does show that the reserve situation is definitely improved. The writer believes that reserve margins of about 15% are adequate for both peace time and war requirements, realizing that they should be greater or less depending upon the individual systems. Improvements in the continuity of operation of equipment and better maintenance have made it unnecessary to have reserve margins as large as formerly. Also, greater coordination between systems has brought about a more effective utilization of generating capability. It is to be expected that there will be still further improvement in the coordination of facilities in the years ahead. The expansion of generating facilities throughout the country may bring about added opportunities for still further coordination.

In considering the extent of reserves for defense purposes, these may be divided into two parts: Those necessary to meet unpredicted loads, and those which are important from the standpoint of possible damage. In the first case, unexpected loads can be met from operating reserves and also from those created by reduction of normal load requirements. In the second case, reserves to meet war damage can largely be provided for by the same operating reserves, also by load reductions occurring as a consequence of action, plus for most areas a small additional reserve. This latter "defense" reserve should be built into the various systems as an integral part of their facilities.

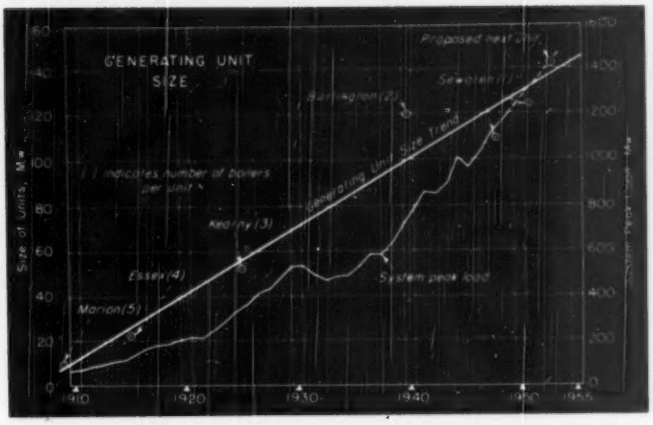
Generating Plant and Unit Sizes . . . Generating plant sizes and locations will remain much the same, as engineering and economic factors generally control the decisions on them. In the course of this expansion many new sites will be developed providing for a degree of desirable spreading. Sizes of units again are influenced largely by system size, location, and will tend to become larger.

Improvement Trends . . . There will continue to be improvement in thermal efficiencies resulting from higher pressures and temperatures as material developments permit. Reheat will be more extensively used and simplified. Binary cycles will receive careful attention and probably further installations will be made. The use of the gas turbine for large projects is probably some time away but it may well serve as a supplemental source for particular systems or areas.

The matter of keeping capital costs low in generating facilities will become increasingly important and more effort will be directed towards this end.

Manufacturing Capacities . . . The manufacturing capacities to produce heavy power equipment are great indeed and will continue in keeping with all demands placed upon them. The impressive scheduled output from the manufacturing plants during the postwar years gives every assurance that they will meet their responsibilities in every respect. In 1950 the scheduled deliveries of steam and hydraulic turbine generator units will be about 7½ million kw, the largest ever. Of this amount, about 600,000 kw will be sent outside the continental United States. The capacities to build such units amount to about 10 million kw per year, divided approximately 8 million kw for steam units, and 2 million kw for hydraulic units. Steam producing equipment can be built at an even greater rate. Power transformer deliveries have caught up with demand and production is adequate. Thus it is evident that the manufacturing capacity for the present and for the years ahead is great.

In Summary . . . The outlook calls for a continuing expansion of generating capabilities. They will be composed largely of thermal facilities, using predominately solid fuels and benefiting by technological advances as they are made. Large scale hydraulic installations will continue. These should be fully coordinated with the thermal facilities if maximum benefits are to be achieved. There should be a continuing engineering and economic evaluation of the two to bring about a better balance. The spirit of the industry will be constructive and inspiring.



GENERATING UNIT SIZE and system peak load trends have been almost proportional

Generation for the 1965 Demand

F. P. FAIRCHILD
Chief Engineer, Electric Engineering Department
Public Service Electric & Gas Company

- Unit sizes to grow with system peaks
- Boilers readily capable of matching turbine sizes
- Pressurized furnaces expected to grow in favor
- Stress on reliability to embrace auxiliaries and controls
- Reheat will capitalize on increased acceptance
- Steam temperature elevation a cautious step
- Gas turbine to run on gas and fuel oil, later pulverized coal
- Cooling towers can broaden latitude on site selections
- Higher voltage generation surely in prospect
- Excitation voltages expected to rise

SOME IDEA of the shape of things to come in thermal-electric generating plants over the future 15-year period may be had by recalling changes in equipment and general station design that have taken place in the past 15 years. The general trend was of course interrupted by the war. The tremendous increase in cost of equipment and structures since the war will definitely stimulate a search for general design to counteract this high cost. Fuel costs will probably not decrease materially if past trends are used as a guide, so that for most sections high thermal efficiency will be indicated. Levels of wages for operating and maintenance labor will have an increasing effect on design.

A most important item in plant cost reduction is the capacity of the unit. There will be a tendency to adopt units as large as possible, consistent with the total system load, even though this may seem to impair system and interconnection flexibility.

Rating Considerations . . . In the utility with which the author is associated the unit size trend has long been approximately proportional to the load, and as long as turbine and boiler manufacturers can produce reliable equipment for larger sizes it is proposed to continue this trend. A curve in illustration is shown at top of this page.

Assuming the present ratio between thermal and hydro power, there is a wide variation in the requirements of the various systems throughout the country inasmuch as these vary from a few thousand kilowatts in numerous municipally-owned plants to three million kilowatts in the largest privately-owned systems. For the majority there will be no problem in procuring capacity in required sizes; for the largest systems bigger units will probably be developed. By 1965 a number of systems will be ready for individual machines considerably in excess of 250,000 kw. Again in order to keep costs to a minimum the turbine-generators should be physically as small as consistent with the design limitations which indicate single-shaft, 3,600-rpm machines up to capacities as large as possible. At present there seems to be no

difficulty in design in the range of 150,000 kw without necessitating blades longer than 23 in. for the exhaust annulus. Twenty-five inches has already been discussed as an imminent possibility. Radically new generator designs for high speed may be developed in the not distant future, thus removing this limitation of single-shaft machines. In some instances for very large units cross-compound arrangements will continue to be used; over-all plant costs will be the determining factor.

Steam generation equipment presents no discernible limitation to size. Boilers of 1,250,000 lb per hr at 1,050 F are being built at this time. Presumably they will grow to sizes needed for the turbines of 1965. There is considerable indication that more boilers will be built with pressurized furnaces affording some inherent increase in efficiency and simplification by omission of induced draft fans.

Economic Factors . . . Design effort in steam generating equipment must be concentrated on increasing reliability, as an apparently trivial failure of minor auxiliaries can jeopardize the operation of an entire large unit. This will be accentuated as there is progressively more resort to automatic controls.

Another factor in cost reduction revolves around simplicity of arrangement of equipment, heat balance, and auxiliary equipment. The single-boiler, single-turbine layout will be more extensively used as residual doubts about dependability wane.

More equipment will be placed outdoors although persistently severe weather conditions in some quarters might prevent going to the limit. Certainly the tendency will be a minimum of enclosed structure which will reflect savings. Noise limitations may also be a consideration. This will impose on the manufacturer more responsibility for minimization of noises to avoid resort to enclosures.

The trend to more reheat units will probably continue, for the unit system makes them fairly simple to design and operate; the economies realized are considerable.

Elevation of Temperature . . . In the matter of steam temperature there seems to be a tendency to pause a while at 1,050 F so far as boilers are concerned, although turbine manufacturers seem to be quite ready for 1,100 F.

Steam temperature will certainly go higher in the next 15 years. Based on laboratory information, materials are now available for considerably higher steam conditions than are being utilized. The application, however, to large units must of necessity be gradual and tempered with considerable judgment. Progress, however, will not be made until these materials are fabricated full size and tried out in service. There is no laboratory substitute for this. Economics should not be neglected but should be viewed with an eye to the future. It is quite possible that both turbines and boilers might be designed with an "expendable" section readily removable but with a shorter life expectancy.

Alternative Cycles . . . For the present the mercury cycle will be confined to the smaller units where fuel costs are well above the average, but by the end of the period under consideration, mercury for the larger units may again be utilized.

Gas turbines in their present state of development will be confined to the smaller systems, as the penalty of the size factor is too great to overcome. However, a great deal of attention is being given the development of this equipment all over the world, and practical ways of increasing size will come. They will also be confined to the areas which burn natural gas and fuel oil, until such time as the coal-burning experiments are further along. Combination gas-turbine-steam plants may possibly be developed before the end of the period. Also, by 1965 a large atomic energy steam plant may be available for installation.

Condensing water is a limitation in some locations but recent improvement in cooling tower practice assures us that this factor will not stand too much in the way of site selections. The present tendency indicates that for saving in cost and simplicity deaeration in most cases will be accomplished in the condenser hotwell. Condensate cooling for generator and other important coolers will be used to a greater extent to provide more reliability at little or no excess cost. The tendency will be to use no more pumps in the plant than are found to be absolutely necessary.

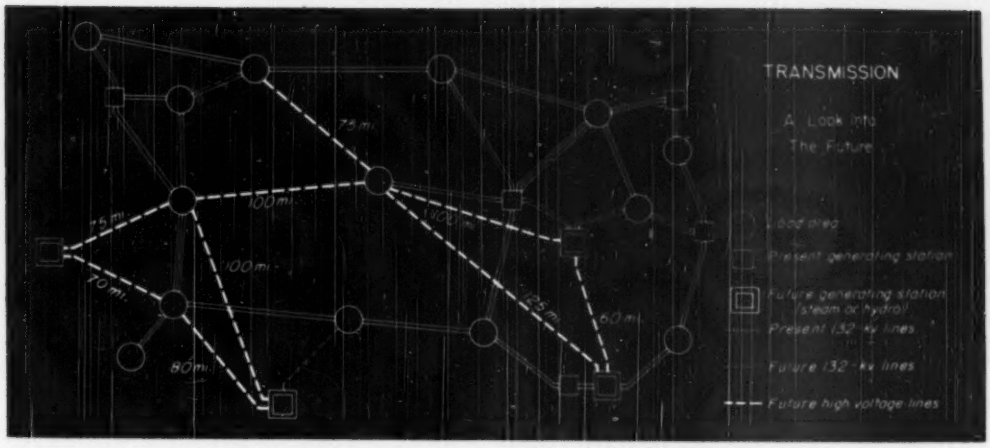
Along with the simplification of plant there will be a reduction in the operating attendance required. Central control rooms along with telemetering and supervisory control will further reduce operating labor costs. Refinements in design will radically reduce maintenance costs, advantageously shorten the offtime for overhaul and at the same time bring about an improved reliability of performance.

Electrical Feature . . . With the larger units of the 1950-1965 period better insulation and better control of temperature rise must be built into the machines. Higher voltage generation will be used and further development of generator leads of high carrying-capacity is indicated.

Fewer circuit breakers per megawatt are likely objectives. There may be an increase in complexity coming with the extension of electrical control to more automatic functions. The larger amount of operating and control mechanisms will, in turn, stimulate intensified development of compact control boards. Centralized control is here to stay.

The larger units will also require closer attention to excitation and regulation development. Direct-connected exciters must show improvement if they are not to be discarded in favor of motor generator or electronic excitation. If either of these latter two systems is used a maximum reliability of source is required. Higher-voltage excitation will be used.

Trend will be to the "buttoned-up" or totally enclosed design of auxiliaries. Delivered to the job as a package-unit, ready for installation with minimum hook-up, this kind of equipment is suitable for both indoor and outdoor service. Its protection against dirt and damage will reduce maintenance as well as noise. Specific examples of growing utilization of such packaged units now include totally enclosed electric motors and variable speed hydraulic couplings.



HYPOTHETICAL TRANSMISSION PATTERN for a widespread network type of electric utility system

Transmission Looks To The Future

Superposition of higher voltage transmission seen as confined to widespread network and long bulk transmission. Higher voltage transmission promises future transmission cost no greater and probably lower than present voltages

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PROJECTING PLANS for transmission systems over the next 10 or 15-year period with double or more than double present loads will require bold vision, and clear unbiased thinking, if the industry is to maintain and improve its present high standards of service on a sound economic basis. Any such projection, of course, requires a coordinated projection of the generation program, for as loads increase it will become increasingly difficult to develop adequate economical generation close to load centers. In a great many systems this alone will magnify the transmission problem. However, the pattern of generation will be such that certain observations can be made with respect to the probable course of future transmission system development.

The doubling or more of load that has taken place over the past decade has been accommodated in many cases by expanding and strengthening existing systems at established voltages. While a good job is being done now, will it be feasible or economical to continue the same type of expansion to handle another doubling or trebling of the load in the future? Or, should higher voltages be superimposed on present systems? The answer to this and other problems involved in planning future transmission systems depends on: (1) Type of system, (2) location of generation, (3) present transmission voltage, (4) transmission distance, and (5) over-all economics.

Types of systems will range from closely-knit metropolitan areas, to far-flung hydro systems involving long-distance bulk transmission from remote sources. In between is the transmission network system that interconnects and integrates a number of load areas and generating plants, either hydro or steam.

I—Large Isolated Metropolitan System . . . Such a system may have a transmission growth problem similar to that of the more widespread network system. But because shorter line distances are usually involved, necessary expansion probably can be taken care of more effectively and economically at the existing voltage provided this voltage is reasonably high, say, 115 or 138 kv.

IN SUMMARY

1. Future projection of transmission plans over a 10 to 15-year period must be based upon a projected generation plan covering the same period.

2. Superposition of higher voltage transmission will be generally confined to two types of system: the widespread network system and the long bulk transmission system. Advantages for the latter type may be less because of possibilities offered by greater development at existing voltage, particularly if this is 230 kv or above.

3. Superposition of higher voltage on the widespread network type system is likely to be required for two reasons: To take care of load growth throughout the system; to provide necessary flexibility for power transfers between load areas and between generating stations.

4. Technical problems of higher voltage are being studied widely, and it is believed answers already obtained or expected soon will assure future transmission costs not greater, probably lower, than at present voltages.

While the voltage itself may be fully adequate, the necessary increase in transmission flexibility may require high-voltage underground cable links that cross the metropolitan area to supplement transmission lines which may partially or completely encircle the area.

II—Long Distance Bulk Transmission . . . For the system involving long distance transmission of bulk power from distant power sources, required transmission capacity will increase only in proportion to the increase in generating capacity developed at these sources. At the same time, magnitude of the transmission problem may increase faster than load to be transmitted if the new generating sources are still further removed.

III—Large Integrated Network Type System . . . This type is typified by the hypothetical system shown. Even though increased generating capacity is more or less distributed, in such a system, major strengthening of the transmission system will be required as system load increases. With general growth in system load as larger units are installed, transmission of power under normal and distress conditions is bound to increase. In providing additional transmission capacity, the requirements that must be carefully considered are:

1. Adequacy of capacity under normal conditions to permit meeting loads by the most effective and efficient loading of plants and units, including internal system loads and loads imposed by non-affiliated companies;

2. Flexibility in transmission capacity, suitable to work in harmony with generating reserves strategically located inside and outside the system. That is, in the event of emergency on any part of the system, the system should be reasonably free of any transmission bottlenecks that might interfere with supply to the area in distress.

Whether the necessary increase in capacity for either the second or third type of system is obtained by expanding the existing voltage, or by superimposing a higher transmission voltage, depends on the existing voltage level, and on the distances involved. On many predominantly hydro systems where long distance bulk transmission is now required, a voltage level of 230-kv or above is already in use. In the network type of system with distributed generation in load areas, lower transmission levels, such as 115 kv, 138 kv, or 154 kv, are more commonly used.

With a system now operating at 230 kv or above, the advantages of superimposing a higher voltage level with its problems of transformation and continuity obviously will be less. The cost of such higher voltage developments will have to compete with the possible lower cost and increased service continuity obtainable by adding 230-kv circuits. This may possibly be combined with increases in the capacity of present and new circuits secured with such devices as intermediate switching, intermediate condenser stations, or series capacitors.

In a network type of system that uses a lower transmission voltage such as 138 kv, for example, the advantage of superimposing a higher voltage level may be much greater in view of the two-fold expansion of transmission requirements previously mentioned. In such cases the superimposed high voltage system will provide all the necessary flexibility for the transfer of large blocks of load from one area to the other, the present lower voltage system will be used not only to supplement the high-voltage system but also as a distribution system to handle distributed loads throughout all of the areas.

It is evident that the principal problems of transmission in the future, as far as superposition of high voltage is involved, will be confined to the long-distance bulk power system or the widespread network type of system. The problems of strengthening metropolitan systems will undoubtedly require additional high-voltage transmission and therefore high-voltage cable. This in itself will not pose drastic new technical problems since cables have already been developed and are now in use up to and including 230-kv. On the other hand, the superposition of higher voltage transmission lines requires not only a considerable amount of further technical development but also extensive planning from both technical and economic standpoints. For this reason the discussion to follow will be confined mainly to higher voltage overhead transmission, particularly the superposition problem.

Higher-Voltage Transmission . . . A great deal of study and research is being carried out both in this country and abroad on the technical problems of high-voltage transmission. In Sweden a line designed for eventual 380 kv operation is already under construction but to be operated initially at 230 kv pending the development and manufacture of the necessary transformer and circuit breaker equipment suitable with the high voltage. In England a short test line has been placed in operation at approximately 275 kv with plans under way for a 40-mile section. This includes terminal transformation equipment and is to be operated as a link in the

138-kv grid looking toward eventual superposition of this higher voltage on the existing 138-kv grid.

As is well known, in this country the American Gas and Electric Service Corporation in cooperation with a number of manufacturers and suppliers of electrical equipment has constructed test lines for operation up to 500 kv. The program of research on these lines includes studies on corona and radio influence as well as the performance of transformers, lightning arresters, circuit breakers, and capacitors under continual voltage stress in all types of weather over a considerable period of time. Both corona and radio influence tests have been and are being carried out on various types, sizes, and spacings of conductors over a wide range of voltages, up to 500 kv. Present indications are that with reasonable conductor sizes the corona problem from the standpoint of actual losses will not offer any major difficulty but that the limiting factors are more likely to be radio influence and economic considerations.

The Economic Factors . . . Economic considerations indicate that the advantages of superimposing high-voltage transmission on an existing system will be important only to the extent that a fairly large step toward a higher voltage can be taken. In the final analysis the choice will be made on an economic basis, looking into the future, not less than 20 to 30 years and taking into account the step-by-step costs of building up the superimposed system. The problem will be to achieve the lowest possible over-all transmission cost for the future system in terms of dollars per kilowatt, or mills per kilowatt-hour handled, without imposing an excessive burden of expenditures during the initial and intermediate stages of development.

Particularly in a network type of system, superposition probably will take place in a gradual, orderly manner, possibly with one or two lines constructed for high-voltage but operating initially at the lower system voltage, postponing major investment in transformation facilities.

What Voltage Level . . . In determining the voltage level which will give the greatest return in kilowatts of capacity per dollar, a great many factors must be taken into account. Radio influence, of course, may impose somewhat of a practical ceiling on voltage level in this country, but many other factors of design are directly related to economic considerations. In some areas sleet is a severe problem and the difficulty of sleet melting goes up rapidly with increase in voltage and corresponding increase in conductor size. Transformer and switchgear costs rise rather rapidly with voltage, along with the necessity for taking care of transmission line charging current at light load, probably with the use of shunt reactors. The amount of total transmission capacity which may be considered advisable to tie up in a single line or right-of-way, is a consideration not to be overlooked. If this value is very high, even though the resulting cost per kilowatt is favorable, difficulty may be encountered in getting the system built up on a step-by-step process at reasonable cost to the point where at least two high-voltage channels are available so that the system shock resulting from the loss of one such channel will not disrupt the system completely from a stability standpoint.

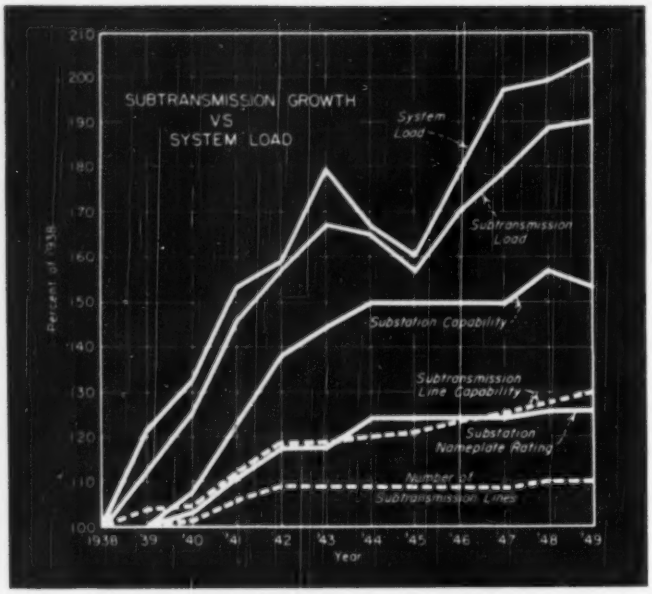
Double vs Single Circuit Construction . . . Another consideration in the selection of voltage is the favorable economics, presently indicated, of double-circuit as compared with single-circuit towers. Here again, a reasonable limit to the concentration of capacity tied up in a single channel or right-of-way will tend to result in a somewhat lower voltage for double-circuit towers as compared with a top limit for single-circuits. If double-circuit construction is chosen, the somewhat lower voltage level, smaller conductor size required, and lower initial investment in terminal facilities, would, in turn, somewhat ease the initial economic burdens.

The voltage step to be taken should be adequate for a long range period. At the same time the advantage, from a stability and reliability standpoint, of several circuits in parallel as compared with, say, a minimum of only two high-capacity circuits, is a factor which cannot be overlooked. For example, with no intermediate switching, the two-circuit layout is subject to a loss of one-half of its total carrying capacity along with a severe system disturbance if one circuit goes out on a permanent fault. With one intermediate switching station an outage of one line section would entail a loss of capacity of one-third of the total. With the same total transmission capacity available in three circuits, the capacity loss for one circuit out with no intermediate switching would be one-third of the total, and one-fifth with one intermediate station.

On the other hand, the advantage of multi-circuit system at a somewhat lower voltage may be only temporary and should not be permitted to overshadow the greater long term possibilities of higher voltage levels.

Interconnection Considerations . . . Still another factor that should be given due weight in selecting the higher voltage relates to interconnection between a number of systems. The many interconnected systems now operating successfully together in this country have been developed by tying together the existing transmission systems. As loads increase and higher voltages are required, it is logical to expect that these systems in the future will be interconnected again at these higher voltages. For this reason the voltage level should be such not only that it will finally tie in with other interconnected systems without the necessity of voltage transformation, but that it will also be high enough to provide adequate channels of interconnection capacity from one system to another. The benefits of strong ties between systems are obvious, both in peacetime and for national security.

With the adoption of superposition of higher voltage transmission levels, it is believed that it will be possible to hold the cost per kilowatt transmitted to existing or even lower values than now experienced at lower voltages. This will undoubtedly mean some new thinking on design, and particularly with regard to insulation levels. Higher voltage lines inherently will have less vulnerability to lightning and can be made fairly close to lightning-proof by the use of ground wires, low footing resistance, and counterpoise installations where necessary. Or, it should be possible to accomplish an equivalent result in performance at a reduced cost by spending less on the line itself and depending on the lightning arrester, combined with ultra-rapid reclosing non-restriking circuit breakers. The most economical design may be a combination of both.



SUBTRANSMISSION SYSTEM compared to system load on Duquesne Light Co for years 1938-1949, over which period the system load doubled. Transformer rating increased 28%

Subtransmission Faces a Decade of Growth

Design trends of next ten years will be keyed to need for more capacity at less cost. Improvement in cable, better methods of rating lines and apparatus, more use of unit type substations and higher voltages seen ahead

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THE FUNCTION of subtransmission is to link bulk power supply with low-voltage distribution. Hence the requirements and limitations of subtransmission are somewhat controlled at both boundaries. Yet the basic principles of planning, held in common with all other elements of the system are to:

1. Furnish adequate service at the lowest possible cost and

2. Make the greatest use of developments in the art without uneconomical retirement of existing equipment.

Looking Ahead 15 Years or so to the time when system loads are double or triple what they are today we may expect to find the basic pattern of subtransmission system not radically different from today's. Design trends will be keyed to the need for more capacity per dollar of investment.

1. It seems doubtful that the subtransmission system can be expanded to handle double load as cheaply as in the past.

2. Investment in present subtransmission will preclude wholesale rebuilding. However, advantage will be taken of the inherent economy of higher voltages as loads increase.

3. The tapping of transmission lines to supply large industrial loads can be expected to slow the rate of

growth of subtransmission somewhat compared to the rest of the system.

4. Time-temperature-deterioration methods of rating transformers and lines, will be used increasingly to guide circuit loading as experience verifies its merits.

5. Standards of acceptable service continuity will guide system expansion into minimum cost patterns consistent with service adequacy.

6. Mounting real estate cost will bring cables into more active competition with overhead lines for single and twin circuit projects. Lighter weight aerial cable using aluminum or other covering will be sought.

Problems to be met in building a system to carry double the present load are clarified by studying conditions when loads were half what they are today. Thus methods that were previously used in expanding subtransmission can be examined and evaluated. For example, system load of the Duquesne Light Co in 1949 was double that in 1938. Looking back at this period suggests that the keynote for future subtransmission system planning might well be "evolution rather than revolution."

The record of this 11-year period shows only a 28% increase in the aggregate nameplate rating of all transformers in the company's bulk power supply stations. In the same interval, the number of subtransmission lines increased only 10%. Such very moderate additions to major units were supplemented by such factors as:

1. Increased rating of transformers and circuits
2. Removal of bottlenecks
3. Reduction in reserve requirements.

From these facts it may appear that a doubling of the load can be accomplished at a minimum of trouble and expense. However, a closer examination of the 1938-1949 period reveals some of the problems that remain to be faced in the next 10 or 15 years. It is unlikely that system load can again be doubled in such an economical fashion.

Wholesale Rebuilding Unlikely . . . The magnitude of the investment in the existing subtransmission systems ordinarily will preclude any wholesale rebuilding. However, it may still be possible to take advantage of the greater economy of higher voltages as loads increase.

On the Duquesne Light Co system, for example, there has been a marked trend toward supplying large industrial loads directly from the 66-kv transmission circuits. This has avoided uneconomical concentrations of load on the subtransmission system. This trend will probably continue. The expected result should be a lower rate of growth on the subtransmission system than on the remainder of the system (see curve).

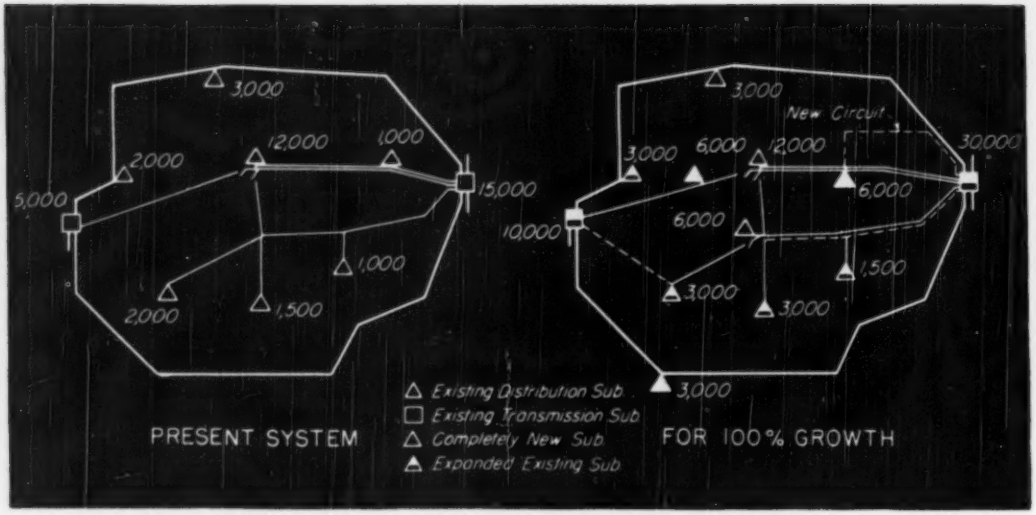
Improved Rating Methods . . . Another factor that has kept the addition of new circuits and transformers to a minimum during the last 11 years was the development of more accurate methods of rating transformers and lines. Time-temperature-deterioration relationships were used to increase ratings without incurring an uneconomical reduction in life. How much farther these practices can be extended will depend upon experience.

Guides to System Planning . . . Reserve is an important element in the cost of a subtransmission system. Improvements are continually being made in circuit and equipment reliability. In evaluating these improvements, the planning engineer must constantly balance service continuity against cost. As service approaches perfection, improvements in the art can be used more and more to reduce cost rather than to further improve service. To rationalize this problem an increasing number of companies have established guides or standards defining acceptable service continuity. These guides result in more economical system development since they often permit a lower cost plan to be selected which—although it may not furnish the best service—will adequately meet the requirements.

Combatting Right-of-Way Cost . . . Because power system engineers are faced with higher and higher right-of-way costs for overhead lines they are increasingly interested in new types of cable that lend themselves to economical application when only one or two circuits are needed. Aerial cable with synthetic or aluminum covering holds promise in some instances because of reduced weight. Trench-lay and buried pipe cables are other possibilities. The trend toward greater use of unit-type distribution substations is another factor in combatting higher real estate costs. The spotting of large numbers of these smaller stations throughout the built-up areas extends the usefulness of the low voltage distribution system. However it requires a more extensive network of subtransmission circuits. Some form of inexpensive cable would be highly desirable so as to properly meet this situation.

The Duquesne Light Co has economically increased the effective capacity of its 22-kv system at two strategic locations by installing specially designed 22-kv combination voltage regulator and phase shifters. Judiciously used, these devices can balance loads on parallel circuits and eliminate low voltage limitations. Thus they make additional capacity available at less than the cost of new circuits. In some cases reactors may be used for the same purpose. A simpler and less expensive regulator for such use would have many applications.

Bulk Power Sources . . . Often the strategic location of a new bulk power supply substation at a weak spot on the system facilitates the development of a subtransmission system. This may, in effect, create new circuits and increase capacity with a minimum of new circuit construction. In principle this is similar to the installation of unit type stations on a growing distribution system, to supply circuits remote from the main distribution substations. Since transmission lines and high voltage transformers can now be made very reliable, some thought should perhaps be given to providing for subtransmission growth in a similar manner. Unattended unit-type transmission substations simple in construction and located at weak spots in the subtransmission system, should provide an economical solution if it can be shown that the frequency of failures and routine maintenance requirements do not cause interference with desired service requirements.



A LONG LOOK AHEAD is essential in planning distribution expansion. In the sketches, above, probable substation locations, capacities and supply are shown for the conditions of 100% and 200% growth above present loads. Projects of each year have a

BLUEPRINTING THE FUTURE

Facing The Future In Distribution

Refinements within the present pattern of distribution design seen as adequate to handle future loads of double to triple present values. Improvements in service, appearance and economy will be focal point of probable trend

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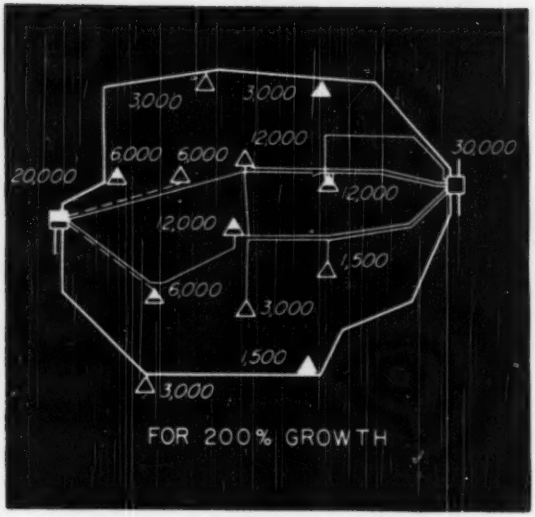
GENERAL LAYOUT and construction details of the distribution system 10 or 15 years from now probably will not be greatly changed from what it is today. Loads, both in kwhr and in kw per unit length of line, will be double or perhaps triple present values. Supply facilities will grow to keep pace with these increases. Poles and overhead conductors will still carry a major portion of the energy for general distribution from enlarged present and added substations. Underground will be extended in the commercial areas.

Within this prediction and the confines which are suggested, there is ample room for further improvements in service, appearance and economy as increases are made in load capacity. Opportunities for new ideas abound even though the general pattern is well established and changes will not appear extensive on a base as broad as the present investment in electric distribution.

With fair assurance of continued load growth and with past experience as a guide, both new additions and rearrangements can be developed along lines of permanence not always possible in earlier years. Recognition of this goal and the need of reducing obsolescence is an outstanding trend in today's distribution engineering.

Long-Range Planning . . . Distribution system plans that show substation locations and feeder areas with as much as 100% load growth have not been widely used until recent years. Keeping distribution abreast of load growth can be largely a matter of replacing and supplementing overloaded units. But a more common practice has been to propose annual budget projects as the need was shown in the load data of the previous year. Long-range distribution system planning has lagged behind similar studies for generating plant and major transmission



goal and direction even though some modifications will very likely be found necessary, and may then be added as the plan is developed

connections. This is principally due to the difference in construction time and finance requirements of individual projects.

Studies made in preparation for postwar construction programs, as well as the material shortages which followed, have influenced the present longer view of planning. Now, with generating capacity approaching that needed for peak load and reserve requirements, the ratio of total distribution capacity to generation is lower than it has been at any time in the past. Investments for distribution and associated subtransmission will continue to focus more and more attention on both load study and long-range plans.

The past record and present prospects indicate that planning for 100% load growth is a minimum requirement. Possibilities should be considered for further growth to 200% above present loads. Every project for the following year can then be presented in relation to expected further additions in later years.

General Distribution Trends . . . While local and individual conditions may indicate other details for a particular situation, it appears that these broad conclusions may be applied in general distribution planning:

1. Four-wire 2,400/4,160Y-v primary with interconnected, grounded neutral is established and will be continued in most general use for urban and suburban feeder circuits in residential and small commercial areas. Some extension of higher voltages into outlying residential developments does not point to a trend toward a general change of urban supply.

2. Primary at 7,200/12,470Y v is indicated for general use in rural distribution, and it is being used in some urban areas in sections of the country where trees have not been a large factor in distribution operation.

3. Although some load predictions suggest more use of three-phase service in residential areas, and this may be necessary in many individual cases, a general change does not seem likely.

4. Radial distribution feeders, with emergency ties to adjacent feeders, will continue as the general pattern. Relatively little further extension of primary networks in overhead distribution will occur.

5. Individual overhead circuit capacities probably will not commonly exceed the present nominal values of 1,500 to 2,500 kva. Consideration of the usual street layout and the cost of underground cable exits will limit the usual substation supply to a maximum of six or eight feeders in residential areas.

6. Use of bus voltage regulation with reduced regulating range will be applied more extensively with increasing load density and shorter feeders. One circuit breaker can also be used for two feeders or trunk sections out to separate load centers.

7. Underground secondary networks, now in general use for the commercial areas of larger cities, will be applied in more cities of perhaps 100,000 population and larger. But it does not appear that this principle will be extensively used in the smaller outlying commercial areas which may be served by overhead primary.

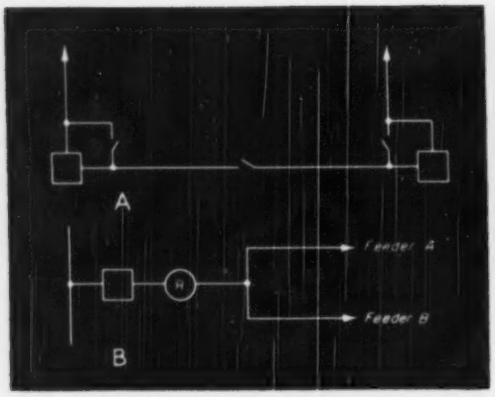
Urban Service Supply . . . For a large part of general urban distribution, the problem of reliability is very nearly solved. Troubles in trees account for the majority of outages and there has not been an improvement comparable to that made with respect to lightning troubles. Even so, the reduction in exposure and feeder length with increasing load densities has combined with improvements in clearances and physical protection to give many average records of primary long-time outages measured in years between rather than number per year.

It is probable that urban feeders will continue to be protected with circuit breakers and overcurrent relays. The requirements of coordination with other protection points require relay accuracy, and the trend will be to continue improvement of the relay characteristics to permit motor load pickup on the circuit following a prolonged interruption. Reclosure at the substation and use of single-shot fuses for branches and laterals of overhead feeders probably will continue in most general use.

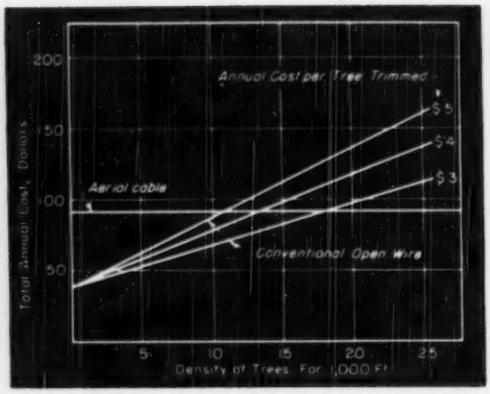
Distribution substations of assembled or factory built units are certain to continue in development and transfer bus and switch provisions will be omitted with more extensive use of less expensive feeder ties. More and shorter feeders in a growing load area will result in greater flexibility for ties and rearrangements and probably will reduce the margin of reserve needed in substation and feeder capacities.

Problems associated with the location of substations in residential areas will undoubtedly continue, with solutions on a local and individual basis in most cases. Masonry or shrubbery surrounding the substations, and other means of improving appearance will be required. Further improvements are also essential to reduce the noise level of large transformers and other substation equipment.

Rural Service . . . Area coverage is about completed for rural service, but rural supply will need increasing attention to keep capacity adequate and to improve reli-



POLE MOUNTED DISCONNECTS for feeder ties (A) simplify substation design by omission of transfer busses and switching. **HIGHER LOAD DENSITIES** will permit more load on each switch and regulator, as in (B), by using one switch for two feeders



AERIAL CABLE WILL INCREASE even though investment is much greater than for conventional open wire. Total annual cost for variable items of one line size breaks even with 11 to 17 trees per 1,000 ft depending on annual cost per tree trimmed

ability. Load growth will be at a higher rate than in other areas of distribution and, as electric service takes on more and more work in farm operations, dependence on it becomes as vital to the farmer as to the industrial concern which suffers loss of production if the service is interrupted.

Continuity of supply on a par with urban service has not been considered possible as lines have been extended farther into rural areas. As loads grow, more substations will be built and feeders will be shortened with a reduction of exposure. The application of automatic circuit reclosers at substations and to provide sectionalizing of branch lines and some points in the main circuit itself will undoubtedly increase. Coordination of several reclosers in series, and in series with fuses, is still in the development stage and will be assisted by further improvement of time-current characteristics.

Single-phase lines account for perhaps 75% of the miles of rural distribution, with only an occasional three-phase service. A general change in this pattern is hardly practical with the increased costs of lines, equipment, services and farm wiring that would be involved, and it does not appear to be necessary. It is more probable that as systems are otherwise improved to handle growing loads, allowable motor size on single-phase will be raised to 7½ hp without causing serious voltage trouble. This is considered adequate for the usual farm machine, with two motors on one drive in rare cases.

Aerial Cable Increasing . . . An increasing use of aerial cable construction is to be expected, particularly with 2,400-4,160 v in suburban residential areas. The high and increasing costs of tree trimming, objections by property owners and civic authorities, and troubles in operation due to tree limb interference with open wires combine to assure this trend. Extensive installations have been made by some utilities and many others have sections of cable on a more or less trial basis. Technical and installation problems are being solved for nominal 5-kv class insulation, but sheath and terminal questions still offer some difficulties in the higher-voltage classes.

Some of the economic questions of cable use are not so clear, however. Aerial cable primary line costs are about double the costs of conventional open wire construction, and it may prove to be more expensive for operation and maintenance of the line itself. Effects of federal income taxes on both investment charges and maintenance costs, and the increases in employee benefits and other indirect charges, are present day factors to be considered in the comparison of annual charges and tree trimming costs.

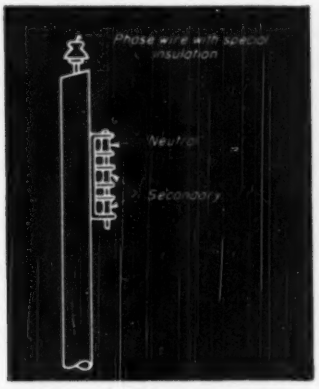
An assembled aerial cable and messenger construction may not be necessary for an improvement in operation of single-phase branch circuits, which account for a major part, perhaps two-thirds, of the primary line mileage in suburban areas. Experience indicates that a change to vertical configuration reduces the primary short circuits in trees which are caused by limbs falling across the open wires or causing them to swing together. An improvement in so-called "tree wire" would offer additional protection for the phase conductor and a common neutral for primary and secondary can be carried in the lower position on the pole.

Underground construction is used to a very limited extent in residential areas and there does not appear to be an increase that would point to a trend in this direction. Costs may be reduced some by trenchlay cable only at the expense of increasing maintenance cost and hazards. Loop circuits with sectionalizing disconnects at each transformer appear to be essential to avoid long outages following cable trouble.

Rear-lot line easements for underground construction offer further problems in operation and in separate service to street lighting. Some real estate developments will justify the extra costs and be willing to pay for

the additional investment, but aerial cable or conventional construction will probably continue to be acceptable in most cases.

Street Lighting Supply . . . Street lighting has been a segregated load throughout its development, with special circuit supply progressing from separate generators to



VERTICAL CONFIGURATION with phase wire insulation tough enough to resist tree abrasion will cut cost compared to aerial cable

mercury-arc rectifiers and to constant current transformers. Meanwhile, the relative position of the street lighting load has changed greatly as other loads have grown, and it is now only about one or two percent of the total. A separate distribution supply may not be justified for a load which approximates the equivalent of a 10- or 15-w night light used by each residential customer. The present interest in aerial cable raises a question on the separate series circuit, and the growing density of distribution transformers increases the difficulty of finding available poles for constant current transformers and primary control switches.

Multiple lamps now parallel series lamps in design and ratings and, except for the most detailed consideration of light variation due to normal voltage changes on the secondary mains, they are equivalent in application. Recent developments of control relays and switches indicate an increasing interest in serving street lighting from the secondary mains. A gradual change appears to be justified as a part of other rearrangements which will be made.

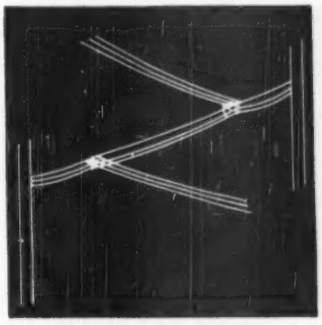
Secondary Arrangements . . . Secondary distribution in residential areas is well established at a nominal 120/240-v single-phase. Introduction of three-phase service or a higher secondary voltage will be discussed, but there appears to be no need or economic justification for the costs which either change would necessitate.

Back in the days when refrigerators represented the major load-building addition to lighting, flicker complaints led to programs of changing secondaries from sizes of about No. 6 to No. 2 wire. The cost of the change probably exceeded investment for normal feeder voltage regulation. Larger wire was eventually justified by load growth, but it is to be hoped that a new version of this investment ahead of load requirements is not necessary for air-conditioning or other large fluctuating loads.

Numerous studies have shown the wide economic loading range of No. 2 secondary, or the size over or under, with an upper limit of five or more times the present average loadings. It is safe to conclude that where No. 2 wire is installed no further change need be made in secondaries for the maximum expected saturations of appliances now in sight.

Average load densities can be served with 15-kva and 25-kva transformers spaced for the demand, which will frequently mean only one span of secondary each way from the transformer pole. Diversified demands of as much as 3 or 4 kw per house will fit this general pattern, with larger transformers in many installations and with a transformer on every pole or otherwise installed in some sections. House heating and other similar loads will undoubtedly develop higher average demands in local areas, approaching in effect the load density of small commercial areas.

Neighborhood commercial centers and smaller town business sections, up to several blocks in extent, are commonly supplied by the overhead distribution feeders which also serve the surrounding residential areas. A variety of service arrangements are in use for these spot areas of higher load density which include large air-conditioning and other power requirements for theaters,



MESSENGER-NEUTRAL SUPPORT of secondary combined with flying tap services could be used to extend spans by 175 or 200 ft

stores and office buildings. No generally accepted plan, equivalent to the primary network of larger commercial areas, has evolved from among many individual ideas which have been developed. Included are separate and combined power and light secondaries, radial, banked or in small networks, served by transformers installed on racks over or along alleys or in sidewalk vaults. This section of distribution planning appears to need more thorough analysis for development of the combination of service and equipment which will best fit the wide range of load densities, total loads and types of loads which must be served.

Electric Rate Forms of the Future

Greater uniformity in styles of rates seen as a growing tendency. Reasonable approach to cost of service, helpfulness in promotion of business and simplicity of design will be sought in future rates

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IT IS NATURAL that electric utility management, looking to the future growth and financial position of the industry 10 to 15 years hence, should inquire now into the forms of electric rates most likely to be found desirable and effective. It is natural that they should consider whether changes in the forms of rates will be necessary and should be planned to meet new conditions.

The question of proper rate design of the future should rest on a sound foundation of experience and reason. Experience in rate-making will show the trends that have occurred in the development and use of rates and the results obtained from their application. Reason will disclose the merit of the observed results and will deduce the nature of future desirable rate forms.

FUNDAMENTAL BASIS OF RATES . . . It should be recognized at the outset that a close relationship exists between the economics of the electric utility industry and its rates. This is natural since the revenues necessary to meet the cost of service must be realized through the application of rates for service. The industry's economics, as reflected by its various costs of operation and its revenue-raising problems, may vary with changes in the national economy. However, economics of the industry are, fundamentally constant in character. Because of this fact, the problems of rate-making remain essentially the same from period to period regardless of changes in the level of costs of doing business and the type and volume of business done.

Value of service to the customer has an important bearing on rates. It follows that the value of service, whether it arises from competitive substitutes or simply from competition for the customers' expendable dollars, must be met by a corresponding level of the rate if business is to be acquired. Simplicity of rates is also desirable since it leads to a better understanding of the charges and, hence, aids in the promotion of business. Value of service and simplicity of rate structure must have a place in the design of rates. However, the narrow margin of profit in this business, its characteristics of production, distribution and marketing, and the need of avoiding unreasonable discrimination require that the rate design give adequate consideration to the industry economics. Since companies cannot afford to supply service at a loss, reasonable returns should be earned not only from the different classes of customers but also from the different types of electric utilization that the customers require. Otherwise, the utility company may find itself, under certain conditions of expanding sales development, in a position of diminishing returns even when no changes are occurring in the general economy.

THE PATTERN OF RATES . . . Management and rate-makers have generally been aware of these requirements from the beginning. Very simple rates were at first adequate for the needs of what was then simple electric service. Growing loads, the increasing complexity of system structure and operation, and a widening variety of uses for electricity that have various load characteristics and values of service, have complicated the rate problems. This situation has been met, over the years, by constant study of the influences of load characteristics on the cost of service and of ways to make rates to fit each situation. This has been done with early and continuing understanding of the economics of the rate problem. After years of dealing with such important problems as satisfactory methods of charging for its service, it would be surprising if the industry had not developed a general pattern of rates that was fundamentally sound, stable and generally versatile.

The 10 or 15 years ahead is not very long compared with the period over which the industry has been developing and its present rate structure forming. In spite of immense strides in the utilization of electricity in the past 10 years, surprisingly little change has occurred or evidently been needed, in the form of its rate structure. This is particularly true in situations where careful attention has already been given the problem of rate design. Little fundamental change in electric rate structure need be expected to occur in such places in the next 10 years or so. Most progress will be made by consolidating and extending the advances already achieved in rate design. Undoubtedly, there will be a growing tendency toward greater uniformity in styles of rates. This movement will be in the direction of those styles which have been found by experience to combine most successfully three important characteristics of a satisfactory rate schedule namely, (1) Reasonable approach to the cost of service, (2) helpfulness in promotion of business, and (3) simplicity of form.

LOAD CHARACTERISTICS . . . The principal load characteristics that affect cost of service are size, load factor and time of use. For the most part, these load characteristics can be dealt with directly in the rate form. Due to variations in the general composition of the loads of different classes of customers it has often been found desirable to use different rates that are applicable to limited classes, such as lighting, power, cooling, heating, etc. Such classification reduces the extent to which a single rate need cover diverse load conditions. Classification, therefore, has lead to rate simplicity. General changes in the composition of class loads, which the future will bring, may tend to alter this situation.

There are often different satisfactory ways for rates to reflect the influences of load characteristics. This should be borne in mind when considering the standardization of rates among the several electric companies. Consequently, in the exercise of managerial judgment regarding what is best in rate-making, exact uniformity of style may be slow in developing, even though sound principles may be adhered to by all companies.

COMPLETE ELECTRIFICATION . . . Careful studies of the problems of the supply and requirements of electric service have now fairly stabilized the forms of the industry's rate schedules for various purposes. However, changes in the economics of the business are almost certain to bring about changes in the rates needed to fit new conditions. For example, it is expected that the network and extensions for electrification of the country as a whole will be completed by the end of 1951. This will mark the advent of a new era in which electric service will be available to almost everyone. The problems of extending lines to reach new customers will have mostly disappeared; attention will then be more completely centered on expansion of customer-utilization of service. Elements of the cost of service which have heretofore had a bearing on the establishment in rate schedules of minimum charges and customer fixed charges will lose a great deal of their importance. There will be a greater tendency to absorb them in the demand and energy components of rate schedules.

RESIDENTIAL DEVELOPMENT . . . Marked growth will undoubtedly occur in the residential use of electricity in the decade or so years ahead. This growth will be fostered by technological development of new appliances for purposes previously limited in application, such as air conditioning, space heating, laundry drying, garbage disposal, television, and many others. Improvement which has occurred in consumer income and savings will also increase the utilization of electric service in homes. Such residential load growth will produce load characteristics more nearly like those of commercial service. It will speed the use of residential schedules having characteristics akin to those employed for commercial service. The industry will, on the whole, find it best to develop residential service under single rate schedules designed to meet the requirements of all types of utilization, so far as unrestricted service to them is economically feasible.

Water Heating is in a special category because of the low rate level necessary to supply the service. The possibility of off peak operation and storage makes the establishment of a low rate possible for it. It is unlikely that foreseeable investment and operating costs levels can result in a rate that will permit this service to be generally furnished economically, if unrestricted as to time of use. For this reason residential water heating service will probably continue to be supplied generally under separate rate schedules for a considerable period.

Fuel Clauses have assumed a place of growing importance in residential rates during the past several years due to the increasing ratio of fuel cost to the total cost of service. About 50 companies are known to include a fuel clause in one or more of their residential schedules. Growing use of major-size appliances and the low level of trailing rates adopted to promote such business will stimulate still further interest in the use of fuel clauses in residential rates.

Trailing Rates are an important factor in the design of promotional schedules. Where the schedule does not include a basis for charging because of differences in the customers' demands, the trailing rate must be high enough to cover the demand component of cost. Such a method does not permit a close relationship of charges to either cost or value of service. Consequently, such rates cannot be made sufficiently promotional and at the same

THE AUTHOR PREDICTS

1. There will be a growing tendency toward greater uniformity in styles of rates that combine: (a) reasonable approach to the cost of service, (b) helpfulness in promotion of business and (c) simplicity.
2. As problems of extending lines to new customers disappear, minimum charges and customer fixed charges in rate structures will lose much of their importance.
3. Growth in residential use will speed the use of schedules having characteristics akin to those for commercial service.
4. The industry will find it best to develop residential service under single rate schedules designed for the needs of all types of utilization.
5. Residential water heating will continue to be supplied under separate rate schedules for some time.
6. Growing use of major appliance will stimulate interest in fuel changes for residential rates.
7. Use of low trailing rates in combination with charges based on demand will probably increase in residential rates.

time adequately compensatory under the various load conditions encountered. Use of low trailing rates combined with charges based on demand will probably increase.

Use of Load Limiters has received some minor support in the hope of promoting sales through low unit charges which might be brought about by enforced low customer demands and increased load factor. The habits and the philosophy of the American public toward living conditions being what they are it is not very likely that limitations on the time and use of electric service will meet with much favor. Consequently it is not anticipated that much progress will be made with rates which feature the use of load limiters.

Residential Rate Form. Regardless of a large overall expansion of sales of electric energy for residential purposes in the next 10 years, there will be many residential customers whose use will be relatively small due to limitations of their disposable income or service requirements. Residential rates of the future must, therefore, aim at two general characteristics: (1) Great simplicity for the small users and (2) more comprehensive relationship to load characteristics and to the cost and value of service for the large user. This will be accomplished, usually, with one general type of residential rate schedule consisting of a combination of block energy rates and some form of charge for demand. The charge for demand will be applied to that portion of the customer's demand that exceeds a specified basic amount. It is too early to tell whether the industry will settle generally on the use of a demand charge component expressed through direct demand charges or through expansion of the size of the energy blocks in accordance with the size of the customer's demand. But it appears that the general preference among rate people is somewhat inclined toward the latter.

COMMERCIAL AND POWER SERVICE . . . Expanding utilization is obliterating the distinction between commercial service and general power classifications. In 10 years, very little distinction between light and power service will remain. The greatest development of rates in this group will be widespread adoption of general service rate schedules applicable to commercial service in a very broad sense. The form of rates for this service must cover a wide range of conditions and give effect to characteristics of demand and load factor. Inclusion of many small customers in the group makes its future rate problem somewhat the same as that of residential service. While the schedules will contain components of demand and energy charges, 10 or 15 years probably will not see a general movement to a single type of rate. However, it is probable that a modified Hopkinson type, having graduated demand and energy charges and a provision to simplify the schedule to a block energy form for the small users, will find great favor because of its adaptability to various customer load conditions.

INDUSTRIAL LIGHT AND POWER . . . The future form of rates for industrial light and power service is more certain than that of any other class. The block Hopkinson type with its graduated demand and energy charges has been found to meet, as far as can be, the varied requirements imposed by cost of service and competitive conditions. Limitations which were imposed in earlier days on the amount or proportion of power for lighting under industrial power rates have been waning as differences have diminished in the value and quality of service, between lighting and power utilization. Eventually industrial light and power will probably become quite universally a single classification.

STREET LIGHTING . . . The outlook with respect to a standard type of street lighting rate is probably more complex and uncertain than any other. This is due partly to differences in local conditions affecting municipal contracts for service and partly to multifarious differences in street lighting equipment and requirements. Where ownership of the street lighting equipment rests in a government agency and the energy service is supplied by the utility company, the matter is greatly simplified and can be treated as a power supply problem. But where the company owns the street lighting equipment conditions are too varied for the rates to be standardized. The situation is much like supplying, maintaining and servicing customers' appliances as well as furnishing the electric energy to operate them. In some individual situations, street lighting rate schedules made up of charges based on types and sizes of lamps, kinds and sizes of posts or standards, kinds of lamp supporting accessories, distance between lamps, etc, have been successfully used. However, in view of the procedure usually followed in street lighting contract negotiations, it is probable that street lighting contracts of the future will continue to describe the character of the service equipment to be supplied and to specify a scale of rates based on the sizes of lamps used in connection with the described equipment.

COORDINATION OF RATE DESIGN AND SALES EFFORT . . . The electric industry came out of the war in a favorable position due in large measure to the fact that its investment had not been expanded much at high cost. However, the postwar period was made difficult by the need of increasing the industry's power capacity to meet the substantial load growth at high construction cost and by the effect of inflation of prices and wages on its operating expenses. Regulatory commissions have recognized the basic duty to see that the public gets service and, to that end, have shown a favorable attitude toward the question of needed rate increases. While rate increases have been helpful where needed, they have been, on the whole, negligible, amounting on the average to about one percent each for the years 1948 and 1949.

With the increased unit cost of construction applicable to the great expansion of power facilities which has taken place in the postwar period, and is still going on, the future of the industry will be somewhat different. Perhaps further and more general rate increases will be required even though not large. In any event, the need of increasing the use-factor of available facilities in order to supply service at the least possible cost is apparent. This means a need for close coordination of effective rate design and efficient sales effort.

Improved Community Relations Are Vital for the Future

Establishing confidence in the company and working closely with employees, customers, stockholders, public and other companies held to be key to continued existence of investor-owned utilities

P. H. POWERS
President, West Penn Power Co, Pittsburgh

HOW TO ACHIEVE GOOD COMMUNITY RELATIONS

1. Establish the confidence of employees in the sincerity of company's policies.
2. Employees need to be informed and aroused to lend their active support as citizens in the fight for private ownership.
3. Maintain and improve reliability of service, promote better use of service, and assist in developing new products and markets to win customer's friendship and respect.
4. Participate in community planning.
5. Provide speakers and program material for all kinds of local meetings and arrange plant tours.
6. Give information to stockholders through annual and quarterly reports and local meetings.
7. Promote stock ownership by customers and employees.
8. We need national educational activities and more effective tie-in at the local level by individual utilities.
9. Each of us must work continuously at our own grass roots—winning the friendship and support of the customers.

THE FUTURE of any investor-owned utility depends to a major degree on its community relations. Bureaucratic action in Washington will be permitted to sweep over us or can be turned back by the attitudes of those in the communities we serve. Fortunately, the people still hold the reins of government. Unfortunately, too many citizens and particularly leaders of our communities do not realize the vital stake they have in the continued existence of their electric utilities under investor ownership, business management and governmental regulation.

Achieving the good community relations that will win wide public support of our free enterprise system depends upon other types such as employee, customer, public and stockholder relations:

Employee Relations . . . Each company needs to establish the confidence of its employees in the sincerity of its policies and soundness of its operations. Employees must fully understand the importance of their company's public relations. They must be persuaded to render and supply all reasonable service in a helpful, friend-winning attitude.

Further, our employees need to be informed and aroused to lend their active support as citizens in the fight for private ownership of our companies. They should be encouraged to take active leadership in all community affairs, including activities that will lead to the strengthening of our constitutional, democratic and representative form of government.

Customer Relations . . . Obviously, each utility must strive to maintain and improve the reliability of its service, to win its customers' friendship and respect as a progressive business concern. It needs to foster both of these by promoting better use of service by customers.

Customers are more understanding of their utility's problems when they are told in advance in a friendly fashion of coming changes in policies, rates and operating

practices. Industrial customers can usually be made friends for life if we assist them in developing new products or markets, and in training their personnel in the proper uses of our service.

The degree of support we can expect from customers on a government power issue will depend on several factors, including the attractiveness of the federal offer, the strings attached, his awareness of principles of basic economics and the resultant loss of tax revenue. Many customers would tend to follow their individual self interests, if the utility has not already laid a groundwork of education and good relations, and conducted an aggressive clear-cut fight on the specific issue.

Public Relations . . . Many types of activities can improve the utility's standing with its public. Aid in community planning to attract new industry and trade is especially helpful, as is cooperation with civic groups that are working to strengthen any element of community life. To maintain its prestige, certainly the utility must join with other business and citizens in reasonable support of local philanthropies.

Almost universal is the utility practice of supplying speakers or program material for a wide variety of local meetings. In recent years, plant tours have become a new channel for winning the public's friendship and understanding.

These activities offer many opportunities for selling the free enterprise system locally. They provide contacts with industrial, business and civic leaders who may well become the hub of a program of community-wide education and information. This leads to employees of local plants and commercial enterprises, and to homes through newspapers, schools, churches and clubs.

Rural communities have granges, educators, clergymen, newspapers and other important influences that can be enlisted in spreading free enterprise education.

Stockholder Relations . . . Stock ownership is a community relations factor if the utility's securities are held by any significant number of local residents, customers or employees. In such cases, the annual report and quarterly dividend enclosures are likely media for messages on such subjects as threat to private ownership, and the importance of community development. There is an important growing practice of holding local meetings for stockholders, for the purpose of discussing company policies and problems.

Where there is wide ownership of stock by customers or employees, this can be a helpful factor in that it creates a proprietary attitude toward the utility, and pride and interest in its welfare. The psychology may be very beneficial, even though the amount of stock held by most individuals might be rather small.

However, the importance to the utility of this ownership interest should not be over-played. Dividends to many smaller holders usually contribute so little to their total income that this might not be the deciding factor in the face of stronger opposing elements. There are dangers, also, if dividends are reduced, even though this should be due to conditions beyond the utility's control.

Selling Free Enterprise . . . Courageous development of the positive factors in employee, customer, public and stockholder relations can build community relations that will support our free enterprise system. The industry must face the fact that it has a sales job to do in this field, convincing customers as to the necessity for preserving this free enterprise system. Up to the present time the social planners and those who hold opposite views have done a much smarter selling job than we have.

Strong community relations can offset and nullify the so-called historic sins of our industry—of which local, state and national politicians have for a long time liked to make capital.

Building good community relations can scarcely be done without expending some employee time and company money. However, the average utility is usually making some contribution of employee time and financial support to community development in a normal promotion of its business. Greater values from such contributions can be derived if they are carefully reviewed and made part of a planned and organized community relations program.

When such a program is established, objectives for building public support can be set, and exenditures of time and money proportioned to the activities that will produce the best results for the community, the local company and the entire electric utility industry.

Coordination of Industry Activity . . . Can the individual utility's problems of community relations be aided by coordination at the national level?

Probably one over-all industry organization, with regional subdivisions, would be an effective and desirable arrangement. It could provide counsel, and complete program plans and materials for use at the local level as needed. Lacking such an organization, the most practicable setup is to have several national organizations serving particular purposes as at present. It is evident, however, that better coordination is vitally necessary if our end objectives are to be attained.

We need national educational activities, such as ECAP, on a greater scale than now. Also, we need more effective tie-in at the local level by individual utilities.

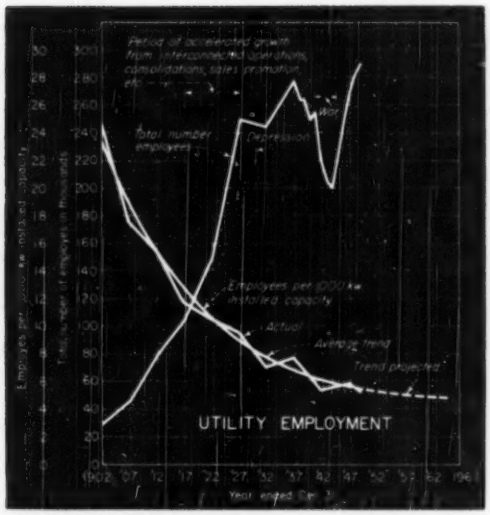
The regional setup of PIP is increasingly helpful in exchanging ideas and methods at the grass-roots level and within those areas where we have common problems. There is need for still further improving service, such as more rapid channelling of information on federal activities and the prompt preparation and delivery of tools to combat undesirable developments.

Local operating companies need every bit of aid that can come from national cooperation and the pooling of our experience and resources. However, the problem of building good community relations lies with each separate utility. Each of us must work continuously at his own grass roots—winning the friendship and support of the customers whose revenue is our lifeblood. We must persuade them that their future as free citizens hinges largely on the extent to which their utilities can be free to own and operate their own businesses and to provide for the future power requirements of the nation, as they have so well demonstrated their ability to do in the past.

Organizational Systems and Employment

More technically trained personnel to provide better forecasting, planning and rate base studies along with more sales engineers are essential for the utility of the future

C. B. COOKE
Vice President, Ford, Bacon & Davis, Inc, New York



EMPLOYMENT TRENDS in the electric utility industry, total of private and municipal plants, are downward per 1,000 kw of capacity

ORGANIZATIONAL SYSTEMS of electric utilities likely mean different things to different people. Therefore, in any forecast of probable trends, over the next 10 to 15 years in these "keystones" of utility services, it is essential first to identify and define the basic elements of "organization" which make up these "systems." In the utilities' usual line and staff organization, such elements may, for this statement, be identified briefly, as including:

1. A systematic arrangement of duties, responsibilities and authorities so assigned to persons appointed to positions fixed in the plan of organization, as to enable them, working individually and cooperatively in groups, to achieve end objects of the enterprise.
2. The whole body of those definite policies, methods, procedures and techniques which make up the "operating routines" under and by which all persons of the managerial, supervisory and operating staffs can carry out continuously all functions involved in the production and delivery of service to customers in ways aimed to promote efficient development of properties, operations and markets.

Every utility is equipped by the processes of management with such organizational systems. In many companies these have been evolved carefully and tested over the years by the experience of "cut and try"; and are flexible enough in plan and applications to meet any changes in operating requirements or advances in the art, so long as there are no radical departures from basic technology, policy and methods of production, distribution and market development or in the procedures of accounting and finance. The trend in these companies' systems will be toward alterations in details rather than to change in basic patterns. In other companies, however, surveys may show that their organizational systems have become somewhat obsolete, or inadequate, in one way or another, to meet requirements imposed by such factors as: Advances in the art; changes in doctrine or policy of state and federal regulation; and growth of "public power" movements. Such companies stand in need of objective studies of their internal organizations such as would disclose weaknesses and point out corrective measures which should be instituted.

Organization-needed surveys for large utilities show that over 75% of total individuals on their staffs are directly or indirectly engaged with performing functions having to do with most branches of the applied sciences. The devising and operation of the multitude of organizational systems needed to carry out such functions can be done only by personnel well trained in their respective technologies and fields of specialization and seasoned, by experience, in the processes of management.

As the industry grows, the need will increase for technicians and other specialists who not only are trained in their particular fields but also educated, as far as practicable, in the work and problems of other departments of the business. To meet this basic need and open up opportunities that will increasingly attract and hold individuals who are qualified for employment in a business so exacting as the electric utilities, there is a need, industry-wide, to build up training programs for the benefit and all round education of personnel. Thus the whole body of it can be developed with due regard to individual aptitudes and inclinations, hidden talents discovered, and full provision made in "line and staff" for future operation. The relative place of company experts and outside consultants differs in each situation but is an important factor to con-

sider in determining short and long term staff needs.

The techniques and scope of market research, economic load building, load forecasting (short and long term) and system planning need further development in many situations. Some managements are not as far advanced as others in such matters. In general, organizational systems as a whole need survey, overhauling and modernization, from time to time, just as much as physical property—perhaps more so under certain conditions. Seeing to it that this is done is part—and a vital part—of efficient management.

Valuation Functions . . . Many utilities under private management provide, more or less adequately, for centralizing those functions which pertain to matters of the "Rate Base" and "Valuation" of property. Due to the many complex factors dealt with in public regulation of the utilities, there is a need to broaden out concepts of the rate base far beyond the usual concept that the rate base of property is its cost. Valuation functions should be so conceived and organized as to comprehend subjects such as: (1) Rates of return, (2) economics of the rate base, (3) evaluations of the processes, (4) effects and advantages of consolidations and integrations through which utilities have evolved as they stand today, (5) impacts of efficiencies of management on the question of allowable earnings, etc. Staffs highly trained in the factors and techniques of such studies will be increasingly needed if the development of both private and public power systems is to proceed along economic and orderly lines.

So-called "going concern value" will not be considered as an item additive to a property base. However, analyses and interpretations in terms of effects on qualities and costs of service of those elements of oragnization which are used to produce better service at less cost, are reflectable in rates of return, when suitably demonstrated. Such elements can be fully proved—and the instruments of proof for any utility with a history of good management are to be found in its organizational systems. They are the work and implements of management, showing the way a property is operated—and the way it is operated is certainly a top factor influential in determining rates of returns such as will attract adequate supplies of new capital and stimulate the efficiencies that better the service and reduce its cost to the users. In such basic matters, the trend should be toward building into organizational systems means for better demonstrating the elements of rate base, in the broad concept of the term, so as to bring the "facts of life" more effectively into valuation and rate proceedings. The processes of demonstration are educative and valuable alike to commissions; also to executives and key men of the service properties—public or privately owned.

Objectively considered, and without prejudice to legitimate projects of "public power," the organizational systems of the "private" industry need a good deal of bolstering in respect to policies and methods for fending off unjustified invasions. More and better organized opposition, on national and local levels, will be needed to meet threats of subsidized competition, in aid of companies desiring to protect interests of their employees, investors in threatened properties and users of their service. There are wide fields and opportunities in this phase of the industry's public relations for building up staff specially qualified and trained to deal with such unjustified invasions as may arise.

Employment Trends . . . The chart shows over-all employment trends for major parts of the industry represented in the "private" utilities and municipal plants. (Federal, State and "Co-ops" representing currently about 15 to 20% of the total industry in terms of generating capacity, are excluded due to lack of employment data.) The line of total employment reflects the 1917-27 growth, due to accelerated development of high voltage transmission, interconnected operations, advance in the art of production and distribution, and the nationwide promotion of sales opened up by availability of more and better service at reduced costs. This chart also reflects the business depressions and recoveries of the 1930 decade, temporary effects of the war and the rapid rise of employment following the war.

The down trend of employees per 1,000 kw of generating capacity (lower line) shows a hyperbolic shape. This is to be expected because of the effects of the great increase since 1902 in size of plant and units combined with interconnected operation and reduced plant labor requirements per unit of capacity. (ELECTRICAL WORLD, April 24, 1950, points out that station forces are from 10% to 65% below the average need prewar; also that new plants of 100 Mw and above require less than half the employees per unit of capacity than needed in the average prewar plant.) The chart shows that the average down trend of total employees per unit of industry capacity seems to be flattening out. Projection of this trend indicates an employment of a little below 5 persons per 1,000 kw capacity in 1965.

Marketing . . . On the marketing side, recent surveys by ELECTRICAL WORLD (March 27, 1950) showed that top sales executives in 51 companies, ranging in size from 25,000 to over 500,000 customers, believe, as a whole, their sales departments are undermanned, but differ widely as to extent of deficiency. The composite belief of this group is, on average, that it would be desirable to double the number of residential salesmen, increase the staff for farm and commercial load building by about 50% and that for industrial power sales by about 10%. Such increases applied industry-wide would indicate that a large field exists for additional employment of engineers and specialists in utility commercial departments.

However, it should be kept in mind that increase in sales man-power does not in itself get better results. Quality, experience and special training of individuals enter in, to say nothing of the organizational systems under which they must perform.

The pressures to increase employment will probably be offset by the effects of betterment in organization and efficiencies of personnel. In such event, it is logical to expect the trend of employment per unit of generating capacity may drop well below 5 persons per 1,000 kw in the future.

Best Dressed Transformer in the Business

YOU MAY NEVER NEED ANY MAINTENANCE on good transformers, if you lick the paint problem. G.E. again gives you by far the best answer. To Glyptal®, the best transformer finish for over a decade, has been added a clear plastic-like material called melamine resin.

Results: 50% *increase in weathering durability!*
50% *greater resistance to water absorption!*
25% *better color!*

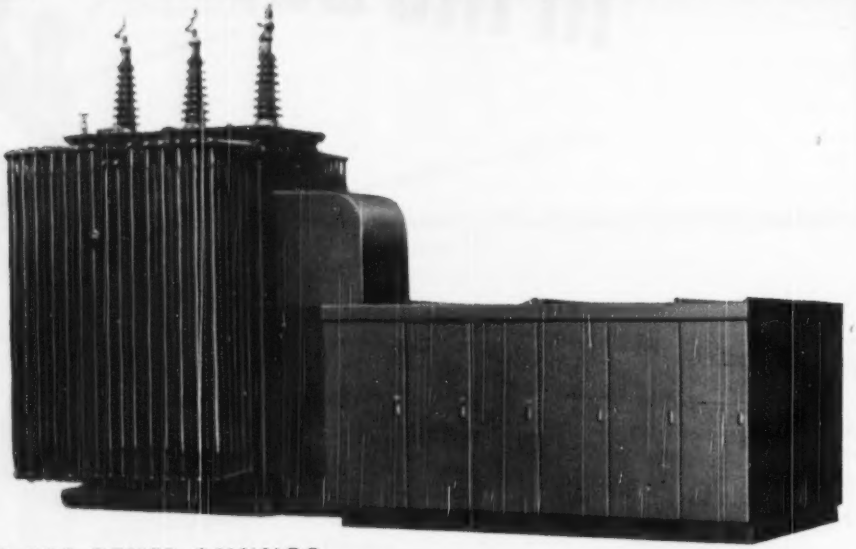
Users of these newly-dressed Spirakore® transformers will discover just how superior this new finish is. When your regular repainting time rolls around, these Spirakores will stand out.

In all respects—Spirakore leads the field. It's the finest distribution transformer we have ever made—the finest you can buy. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

UNIT SUBSTATION

over FIELD-ASSEMBLED TYPE



Typical G-E Master Unit Substation

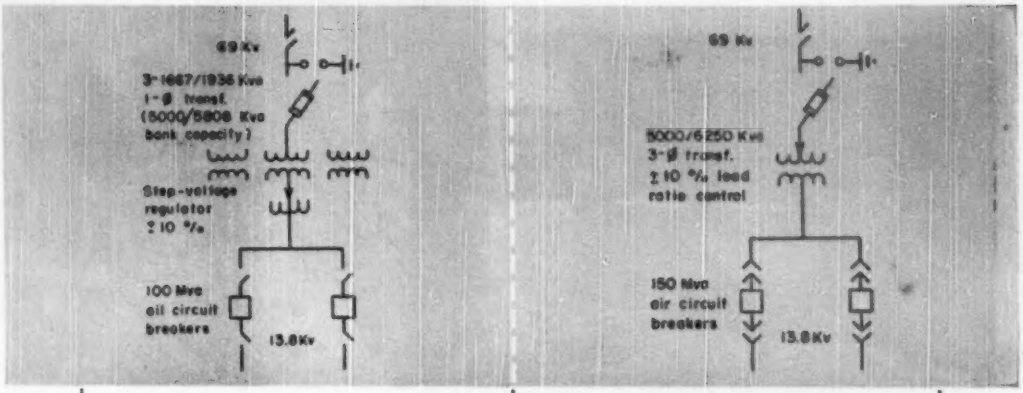
HERE ARE OTHER SAVINGS.....

When you order General Electric Unit Substations your engineering involves only a simple one-line diagram like the one at the right. We do all the detailed specs, prepare construction drawings, electrical diagrams, operating instructions and other paper work to give complete co-ordination of the project—all this on one purchase order, and at lower costs than field-assembled types.

For further information ask your G-E Sales Representative for the publications listed or write to *Apparatus Department, General Electric Company, Schenectady 5, New York.*

Master Unit Substations	GEA-3800
Single-circuit Unit Substations	GEA-4300
Package Substations	GEA-4500
Rural Package Substations	GEA-5276

SAVES 8.7%



FIELD-ASSEMBLED TYPE	
MATERIAL AND LABOR	$66,182
OVERHEAD (20%)	13,236
	$79,418

G-E UNIT SUBSTATION	
MATERIAL AND LABOR	$60,424
OVERHEAD (20%)	12,085
	$72,509

SAVINGS by installing G-E UNIT SUBSTATION $6,909 or 8.7%

In this typical cost analysis* that shows the obvious advantage of using General Electric Unit Substations purely from an investment standpoint, the labor estimates on both jobs were the minimum, a factor that favored the field-assembled type. As G-E Unit Substations arrive in large, completely-assembled units they are installed faster and easier, with lower labor costs.

Note that 20% overhead was added in both cases. For a comparison of *real costs*, 10% on the G-E Unit Substation against 20% on the field-assembled type would be more reasonable. Overhead is reduced when you order G-E Unit Substations because weeks spent in tedious engineering and detailing individual items are eliminated, at definite savings to you. Another item in favor of the G-E Unit Substation is its fan-cooled rating—442 kva greater than the field-assembled job. At a conservative $5 per regulated kva this gives you further savings in favor of the Unit Substation.

*For one installation in 1949.

MATERIAL AND LABOR	$66,182
OVERHEAD (20%)	13,236
EXTRA FAN-COOLED CAPACITY	2,210
	$81,628

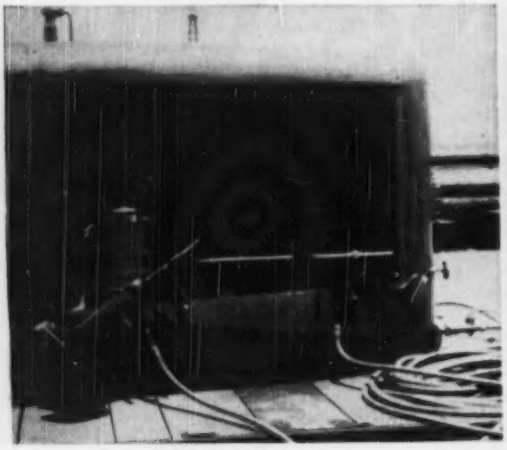
LET'S EVALUATE

MATERIAL AND LABOR	$60,424
OVERHEAD (10%)	6,042
	$66,466

SAVINGS by installing G-E UNIT SUBSTATION $15,162 or 18.6%

GENERAL ELECTRIC

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN



HIGH-PRESSURE NOZZLES mounted on gun-type stocks have helped cut by three-quarters the man-days required to clean de-energized insulation and bushings in S. Calif. Edison's substations

SCOURING ACTION of water stream at 600 to 800 psi has proved satisfactory in areas subject to severe industrial contamination and salt air exposure. Surrounding structures are washed at the same time

Clean Insulators in One-fourth the Time

H. L. RUDOLPH
Supt of Substations
Southern California Edison Co
Los Angeles

MAN-DAYS required to wash de-energized insulators and bushings in Southern California Edison Co substations have been cut 75% over conventional methods by a portable washing outfit. In addition, this outfit can be used to wash surrounding structural iron, screens and other components to eliminate dirt which in time would cause contamination of the insulators.

Equipment used includes a standard orchard spray outfit and a 500-gal tank mounted on a truck. The pump unit is driven by a 4-cyl gasoline engine and supplies working pressures of 600 to 800 psi. Two 50-ft high-pressure hoses can be coupled together or used separately with two nozzles on the unit's two high-pressure outlets.

Nozzles mounted on gun-type stocks for ease of handling are operated by a trigger action. Nozzle orifices of either $\frac{1}{4}$ or $\frac{7}{16}$ in. diam have proved satisfactory. Best results have been obtained generally with washing done at a distance of from 10 to 15 ft.

Severe industrial contamination plus salt air exposure in this area makes cleaning of insulators and bushings a major problem. This washing outfit has so satisfactorily decreased tedious and costly hand cleaning that similar units will be provided for most divisions of the company.

Ledger Sheets Receipted by Drilling Hole

WHEN the customers' bill form is prepared by The Dayton Power and Light Co a calendar block ($1\frac{1}{8}$ x $2\frac{1}{4}$ in. in size), which contains the days of the month from 1 to 31, is printed on the back of the customers' ledger record. In the process of posting cash payments to customers' accounts, the ledger records are removed from the ledger pack on all accounts which have been paid in full. After the cash is proven, these ledger records are receipted by drilling a hole, by means of an electrical power drill, through the correct day of the month in the calendar block. This scheme saves considerable time and effort over the former method of stamping each account paid by means of a rubber stamp. Approximately 200 ledger records can be receipted with one stroke of the drill.—A. P. Hill, Supervisor of Customers Bookkeeping Dept.

DO YOU KNOW THAT switched capacitor equipments LIKE THESE now cost less than $7.00 per kvar?

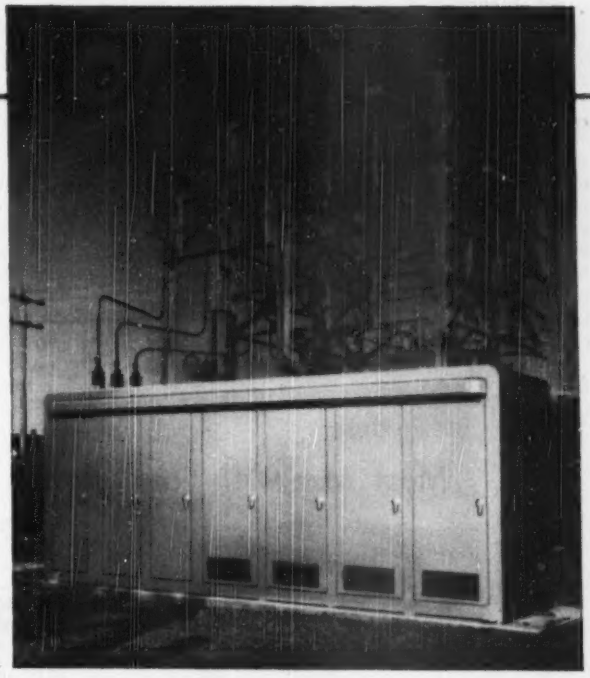
At this low price you should re-evaluate the dollar-benefits that switched capacitors can give you.

Are these conditions present on your system?

(a) Overloaded transformers?
(b) 20% or higher losses on peak?
(c) Low voltage at time of peak or during emergency?

To improve these conditions, you can buy General Electric 13,200-volt automatically switched capacitor equipments for as little as $6.35 per kvar. A small installation expense (1 to 3 dollars per kvar) will have these capacitors operating on your system, economically supplying kilovars, in a matter of days.

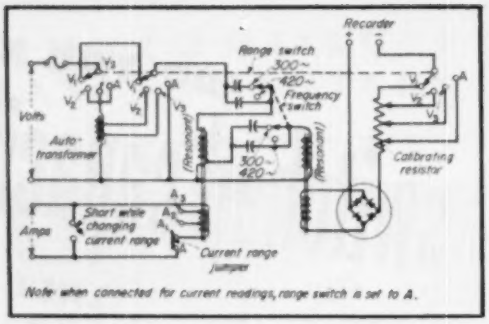
It will pay you to consider General Electric switched capacitor equipments for your system—to alleviate peak conditions at a price no other method can match. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



More and more utilities are making large savings with capacitors—often installing capacitor kvar totaling between 20% and 50% of their system peak load. Above, a 1620-kvar capacitor equipment on the system of the Portland General Electric Company, Portland, Oregon.

GENERAL ELECTRIC

HARMONIC RECORDER consists of filter unit (left) which has no tubes, batteries or amplifiers. Recorder (right) is a conventional 0-250 microamp, dc, inkless strip chart. Six of these harmonic recorders have been used to take simultaneous readings during studies of fifth and seventh harmonics on the transmission system of BPA



FILTER UNIT measures either fifth or seventh harmonic content of nominal 60-cycle waves. It offers three nominal voltage scales from 0.2 up to 25 v rms, and three nominal harmonic current scales from 1 up to 250 microamp rms. In operation, microamperes recorded are converted to true values by curves plotted for each scale

Harmonic Recorder Improves System Operation

L. R. SPAULDING
Electrical Engineer
Bonneville Power Administration
Portland, Ore.

To STUDY EFFECTS of fifth and seventh harmonics on power system operation, Bonneville Power Administration has developed a harmonic recorder designed for direct connection to conventional metering circuits. It is arranged for quick conversion for either voltage or current measurements, with scales covering a wide range of harmonic values.

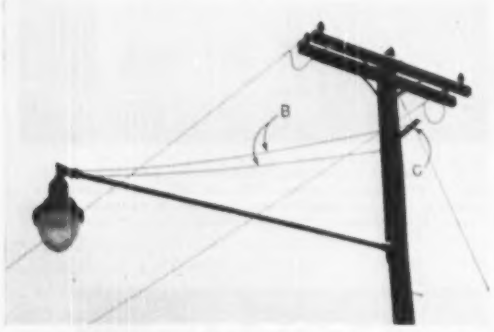
Need for such studies arose when wave analyzer tests showed that in many cases fifth and seventh harmonics were major contributors to system telephone influence factor (TIF) and resonance problems. Many of these harmonics were directly traceable to rectifier loads in aluminum plants, but they also appeared to be transmitted throughout the Bonneville system.

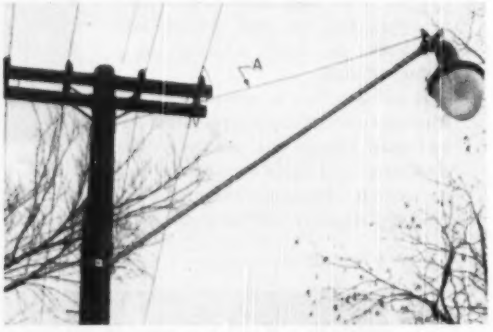
To study these harmonic voltages and currents simultaneously at various points, six harmonic recorders were built. The recording component is a conventional 0-250 microamp, dc, inkless strip chart recorder with chart speeds of either 1 or 3 in. per hr. The second component is a filter unit built without tubes, batteries, or amplifiers. It selects either the 300 or 420-cps component from a complex wave, rectifies it and feeds it directly to the recorder. Due to the low current requirement (0.11 amp) of the small 115-v ac driving motor, it may in some cases be possible to supply the recorder from a metering potential circuit when station service voltage is not available.

Analysis of charts taken simultaneously has shown the effect of various system changes on harmonics at different points. Knowledge of these effects has helped minimize related operating difficulties.

• • •

Mast Arm with Few Parts is Easily Installed

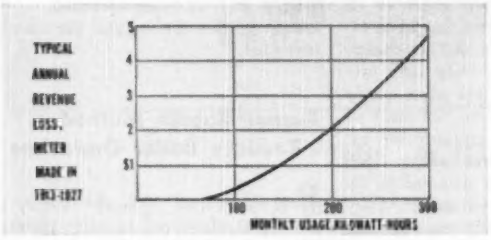




MAST ARMS for street lighting have been streamlined by Cincinnati Gas & Electric Co. New arm (right) has only one supporting rod (A) above the mast arm. This rod is very easily fastened to the pole with an eyebolt. Old mast arm (left) was supported by two rods (B), which were fastened to the pole with a brace (C). New mast arms with fewer parts are easier to install than the old type

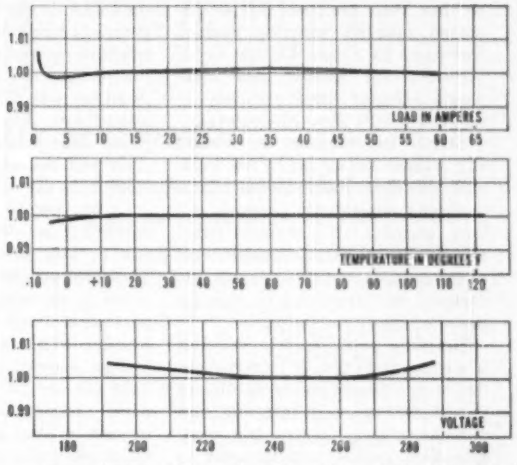
Be thrifty - use the I-50

NO FREE KILOWATT-HOURS!



This curve illustrates the expensive economy of using old watthour meters. Because of under-registration at high loads, lost revenue can amount to several dollars per year per meter. Adjustments can not prevent this loss in revenue —only a major rebuilding operation can do that. But fortunately, there's a better way . . .

With the General Electric I-50, today's most modern meter, there is no under-registration at high loads—no free kilowatt-hours. As shown in the characteristic curves at the right, accuracy under variations in load, temperature, and voltage is mighty close to perfect. This, in turn, means that your billing will be close to perfect.



Ratio of I-50 readings to true kilowatt-hours; I-50 meter rated 15 amperes, 240 volts, 60 cycles, 3 wire, at unity power factor.

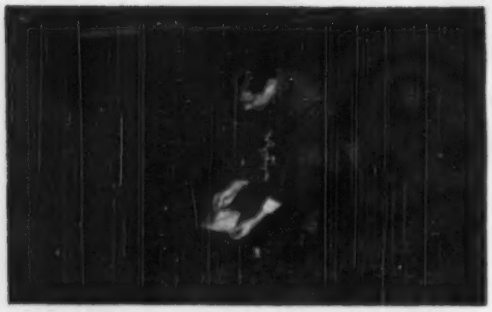
time to retire . . . old watthour meters?

It may cost you more to keep an old watthour meter in service than to replace it with a modern I-50. Here are the reasons:

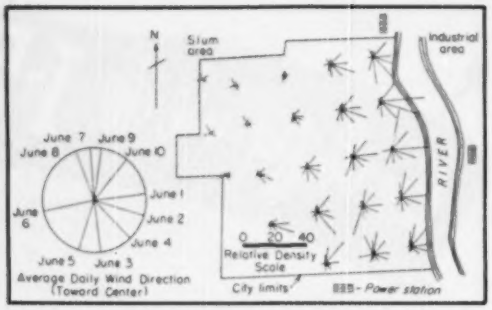
1. **Loss of revenue at increased loads**
2. **Excessive operating expense**
3. **High cost of rebuilding and modernizing**

Adopt the I-50—today's most modern meter—as your standard. It earns more—by proper overload registration. It saves more—by its design for stability of accuracy, less maintenance. Ask your G-E representative for full information. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC



ADHESIVE PAPER placed in special holder catches and holds dust and ash falling on the cutout area. After exposure the paper is covered with a clean sheet and trimmed to include only the exposed area. This technique was used in tests in St. Louis and indicated that flyash constitutes only a minor portion of airborne contaminants



DUST-FALL DISTRIBUTION in St. Louis is recorded for 10-day period. Vectors converge on location of each sample collecting station. Direction of vectors indicates wind direction for given day; length of vectors shows relative density of fall for given wind direction. Note that dust fall was heaviest in most stations when wind was easterly

Dust-Fall Sampling Determines Amount of Flyash in Air

Conclusive evidence that flyash from steam generating stations in St. Louis, even prior to installation of dust collectors, amounted to only 10% of the total dust and ash in the air has been presented by an improved dust-fall sampling method. Developed by Union Electric Co of Missouri, this scheme uses transparent adhesive strips variously located to sample dirty atmospheres.

Simple but effective, the method (1) is easily carried out by few workmen; (2) obtains samples that can be examined immediately or stored for long periods; (3) permits either quantitative or chemical measurement of the sample; and (4) is easily understood and interpreted by both the power company and the public.

Sampling paper used in the tests is a transparent film of cellulose acetate, with adhesive on one side heavy enough to catch and hold ash, dust particles or large cinders. It is available from several manufacturers in large rolls with the adhesive side temporarily sealed by a removable masking sheet.

Mountings for holding such paper consist of a wooden base, and a sheet metal template with a 5 x 6 in. cutout held in place by metal lugs (see photo). The template holds the adhesive sheet which catches and holds any dust falling on the cutout area.

Sampler holders are mounted on distribution poles 14 ft above ground, in positions carefully chosen to prevent the samplers from being shielded by buildings or trees, or from being biased by local dirt-producing conditions. In operation, the absence of "piling up" in corners or sides was convincing proof that little or no dust once caught was blown about or off the holder. It was found that 24-hr exposure to atmosphere did not change adhesive properties. Only with prolonged exposure or old paper partly dried out was there any evidence of sample loss. After exposure the exposed sheet is covered with a clean sheet and the edges trimmed to include only the exposed area.

In one test 60 pole stations were serviced in an 8-hr day for a 10-day run by two men in a light truck. These 600 samples were graded quantitatively by using a selenium type photoelectric cell and meter in conjunction with a lamp on a constant voltage source. The percentage of light cut out by an exposed transparent sample relative to that passing through a clear sample determined the density index of ash fall. By chemically dissolving the exposed acetate paper and weighing the resultant ash in each, relative density was correlated to absolute quantities of ash fall. Further correlations were made for 10 days between daily samples and wind direction and velocity.

It has been found in working with laymen groups that the transparent film samples are readily understood and appreciated. By pointing out the size of much of the dust particles and their complete lack of resemblance to a sample of pulverized fuel ash, attention can be better focused on the nature of the problem. In addition, such phenomena as agglomeration of fly ash particles discharged from electrostatic precipitators have been caught, and the cause corrected.
caught by this method and the cause corrected.

Burner Repair Method Reduces Boiler Downtime

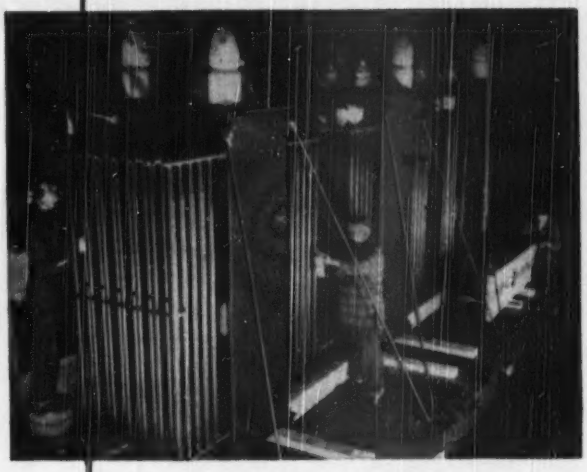
Boiler outage time, for the replacement of burned impeller plates on combination oil and gas burners, has been cut in half by a new way of removing and replacing burners.

Previously, removal of burner assembly necessitated the cooling down of a boiler for 24-36 hr so that it could be entered. However, the operating crew at the Wichita Plant of Kansas Gas and Electric Co has developed a method for removing the burner without entering the furnace.

By pushing a wire through the burner tube and working it out one furnace door, the burner assembly can be slid on the wire and out through the door. To replace the burner, the procedure is reversed. While this method requires shutting down the boiler it does not require as much cooling time as the previous method did.

On trial, a boiler was dropped after the evening peak and allowed to cool until early morning. Then the impeller plate was replaced. The boiler was on the line by 7:30 AM.

$1350.00 Saved! on 3 transformers by purchasing RM*



* RM means "Repetitive Manufacture"—a type designation covering G-E power transformers with standardized construction and preferred-listed ratings up to 10,000 kva and 69 kv. This effective standardization, sensibly flexible with optional features, gives you lower cost and faster shipments.

THIS ACTUALLY HAPPENED!

Purchaser asked for quotation on these transformers:

3 transformers, 1000 kva each
Primary—22.7 kv
Taps—4 above primary, in 600-volt steps
Impedance— 6%
Oversize bushings

Our quotation:

Shipment— 13 weeks
Price— $12,807 net

We also quoted on RM-standard transformers as an alternate:

3 transformers, 1000 kva each
Primary—22.7 kv., an optional RM voltage
Taps—4 above primary, in 2½% (568-volt) steps
Impedance— 5½%
Oversize bushings—an RM option included in price.

Our alternate quotation:

Shipment— 6 weeks
Price— $11,457 net

Purchaser bought RM. Complete shipment actually made in five weeks. He saved 8 weeks in delivery, more than 10% in cost.

Ask for catalog GEC-479. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

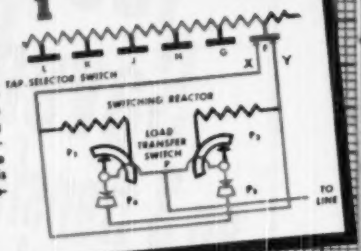
GENERAL ELECTRIC

NEW PRINCIPLE OF REACTOR SWITCHING FEATURED ON MOLONEY

SCHEMATIC DIAGRAMS showing sequence of switching operations and how Switching Reactor loss is eliminated in all operating positions on 1¼% step voltage regulating apparatus and in half of the positions on ⅝% step voltage regulating apparatus

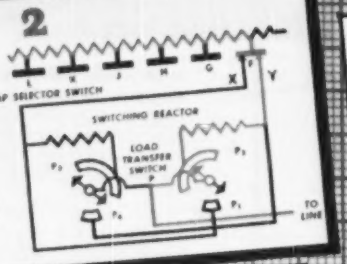
1

Switch positions for Load Tap Changer Operating Position No. 1 on either ⅝% or 1¼% step voltage regulating apparatus (assuming Reversing Switch is in Buck position). A 10% voltage buck is provided in this position. Note that reactor is by-passed.



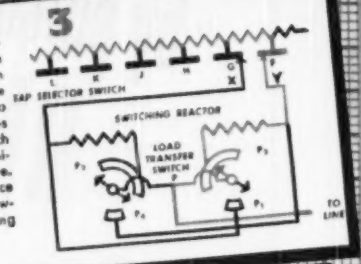
2

Assuming there has been an increase in load and the line voltage decreases, the Automatic Control, after a time delay, actuates the driving motor. The motor drive mechanism rotates the Load Transfer Switch 45° counter-clockwise, shunting all of the current through one half of the Switching Reactor.



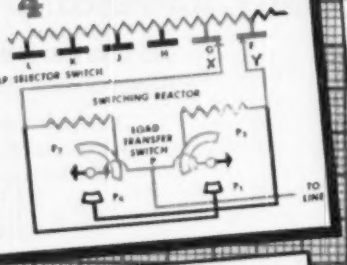
3

While the Load Transfer Switch remains in the position shown in Fig. 2, the motor drive mechanism continues to operate and rotates the Tap Selector Switch to the bridging position illustrated above. No arcing takes place since no current is flowing through moving contact X.



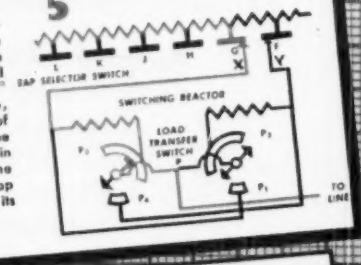
4

Load Transfer Switch rotates 45° counter-clockwise and Load Tap Changer is then on bridging position (Operating Position No. 2), raising the output voltage ⅝%. Current now flows through both halves of reactor. Tap change has been completed on ⅝% step apparatus. On 1¼% step apparatus this is a transitory position.



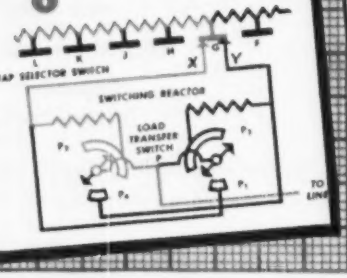
5

On 1¼% step apparatus the motor drive continues to operate and rotates the Load Transfer Switch 45° counter-clockwise, again shunting all of the current through one half of the reactor in preparation for the movement of the Tap Selector Switch to its next position.



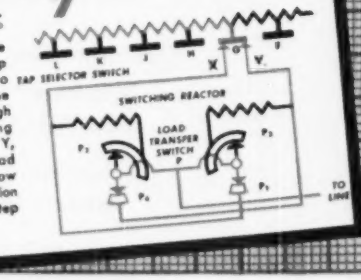
6

With no current flowing through moving contactor Y, the Tap Selector Switch now moves to the next position with X and Y on stationary contact G.



7

Next, the Load Transfer Switch rotates 45° counter-clockwise to complete the tap change. There is no reactor loss since the current flows through parallel by-passing circuits X, P1, P and Y, P4, P to the line. Load Tap Changer is now in Operating Position No. 2 on 1¼% step apparatus.



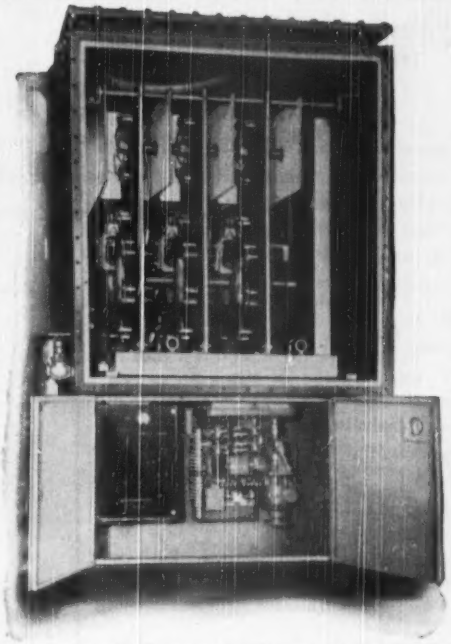
Another Superior **MOLONEY** *Product*

LOAD TAP CHANGERS

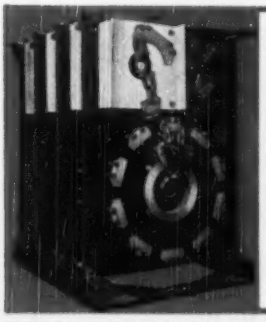
"M" SERIES LOAD TAP CHANGERS USED ON MOLONEY STEP VOLTAGE REGULATORS, POWER REGULATING TRANSFORMERS AND LOAD RATIO CONTROL TRANSFORMERS INCORPORATE REACTOR BY-PASS SWITCHING

SWITCHING REACTOR LOSSES ARE *ENTIRELY ELIMINATED* ON VOLTAGE REGULATING APPARATUS WHEN REGULATION IN 1¼% STEPS IS USED

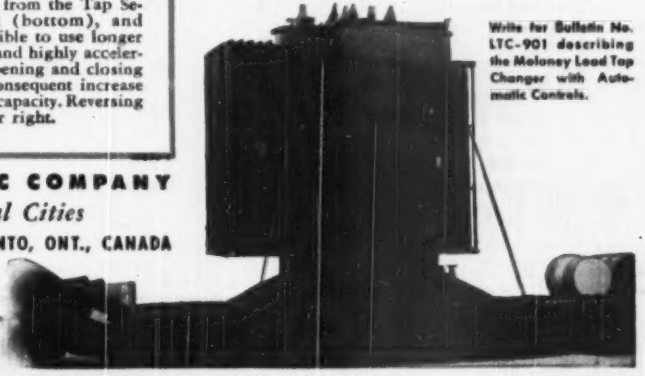
Moloney "M" Series Load Tap Changers are provided on Load Ratio Control Transformers, Power Regulating Transformers, and medium and large ratings of Step Voltage Regulators. A separate switch is used for breaking load current, a feature heretofore supplied on only the very large ratings of regulating apparatus. The design of this switch and the timing of its operation in conjunction with the Tap Selector Switch, are such that the Switching Reactor is by-passed in *all* operating positions on 1¼% step apparatus and in *half* of the positions on ⅝% step apparatus. Since no current flows through the reactor when it is by-passed, there are no reactor losses. How by-passing is accomplished and the sequence of operations in changing from one tap position to another, is illustrated on the opposite page.



Moloney three-phase Load Tap Changer with automatic controls. Top assembly contains Tap Selector Switch, Load Transfer Switches and Reversing Switch. Motor drive and auxiliary equipment are at lower right. Automatic controls are at lower left. Moloney Automatic Control equipment features a supersensitive voltage regulating relay and an electronic time delay circuit. A complete line of remote-manual and automatic controls and associated equipment is available.



The Tap Selector Switch on Moloney Load Tap Changers does not have to perform the dual function of breaking current and changing taps. A separate Load Transfer Switch (upper left) makes and breaks the circuit, eliminating all arcing duty from the Tap Selector Switch (bottom), and making it possible to use longer arc clearances and highly accelerated breaker opening and closing speeds, with consequent increase in interrupting capacity. Reversing Switch at upper right.



Write for Bulletin No. LTC-901 describing the Moloney Load Tap Changer with Automatic Controls.

MOLONEY ELECTRIC COMPANY

Sales Offices in all Principal Cities

FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA

A Method for Estimating Requirements of Transformer Cooling Fluid

TYLER G. HICKS, Summit, New York

Chart permits quick estimates of cooling fluid flow rate for forced-oil-cooled, synthetic-fluid-cooled and water-cooled transformers, also allowable transformer kilowatt loss. It is useful for performance checks, design estimates and comparison of various units

Example for Use of Chart

Problem: How much oil at an initial temperature of 25 C is needed to cool a transformer with a 100 kw loss if oil temperature rise is 24 C?

Solution: Enter the chart at a 100 kw loss and project to an initial temperature of 25 C(abc). From the intersection (b) with the reference line, project to 24 C temperature rise, (dbe).

Result: Read 40 gpm, flow required.

CHART is based on the equation*

$G = L/TK$

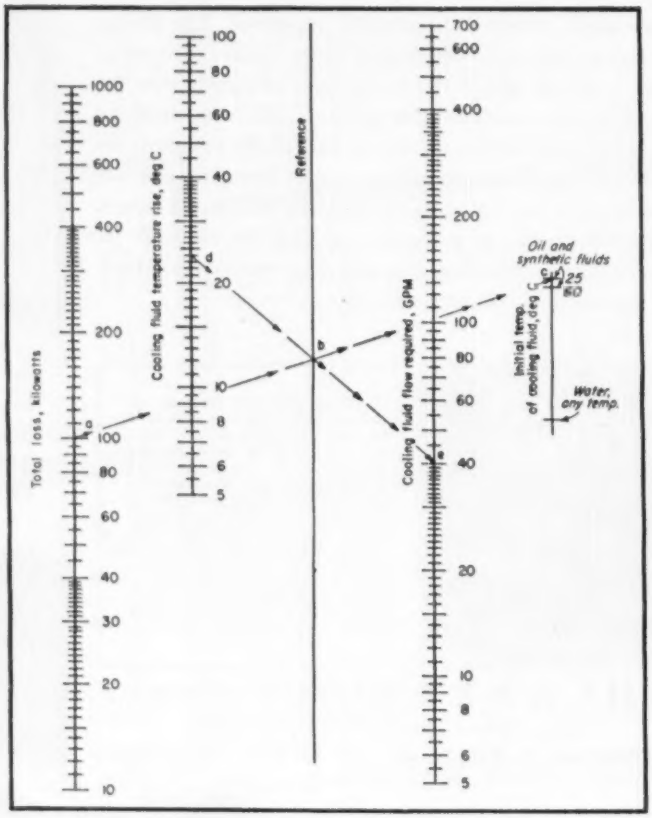
where

G = cooling fluid flow rate, gallons per minute

L = total loss, watts

T = cooling fluid temperature rise, deg C

K = a constant depending on initial temperature of cooling fluid; it varies from 104 for oil or synthetic liquid at 25 C to 264 for water at nominal temperatures

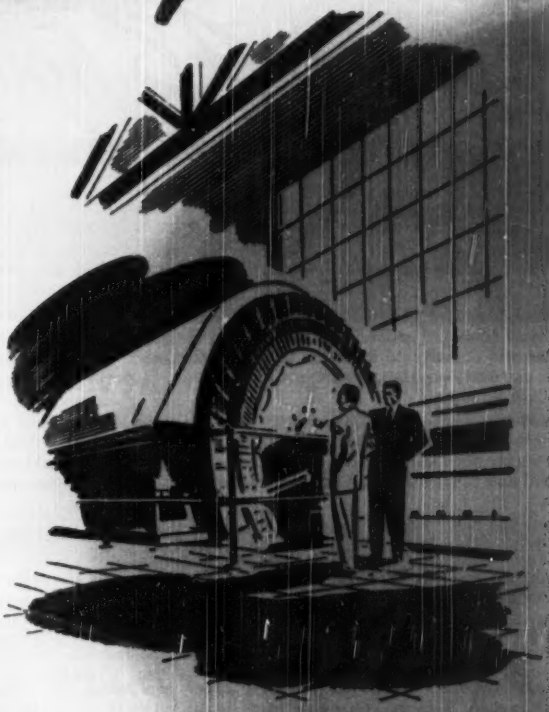


THIS CHART is useful also for performance checks, design estimates, and comparison of various units. By entering the chart with an available flow rate, temperature rise, and initial temperature, the allowable loss can be found in a manner similar to that described at left

* Equation and constants used in plotting this chart can be checked in STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, McGraw-Hill Book Co, 1949, Sec 6, par 73, Eq (6-36).

For best service where circuits heat up . . .

Today it's Roebling!

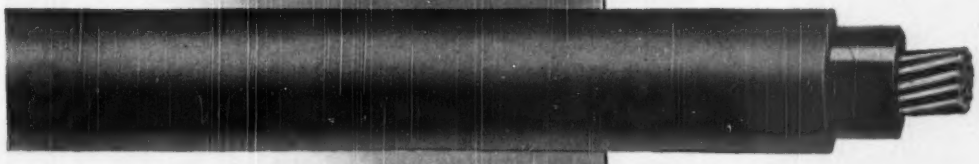


V. C. Cable that stands the gaff

NEXT TIME YOU NEED new leads for motors, generators, transformers or oil switches, make them Roebling Varnished Cambric Cable! There's nothing better for heat resistance . . . they'll give you brand new dependability . . . save you time and money!

Roebling Varnished Cambric Cable is made in single and multiple conductor types—single, from 2,000,000 C. M. to No. 14 A.W.G.—multiple from 500,000 to No. 14 A.W.G. Both constructions are adapted for use up to 17,000 volts between phases for unshielded multiple conductor . . . up to 21,000 volts between phases for single conductor and shielded cables on ungrounded neutral systems . . . up to 28,000 volts between phases for single conductor and shielded cables on grounded neutral systems.

Write for full information, or call on your Roebling Distributor—he'll be glad to help. John A. Roebling's Sons Company, Trenton 2, New Jersey.



From copper conductors to protective jackets, Roebling electrical wires and cables (more than 60 standard types) are made entirely in Roebling plants. Engineering and the most modern techniques and precision machines assure quality products, unexcelled for service and economy.

ROEBLING

A CENTURY OF CONFIDENCE

Atlanta, 934 Avon Ave. ★ *Boston*, 51 Sleeper St. ★ *Chicago*, 5525 W. Roosevelt Road ★ *Cincinnati*, 3253 Fredonia Ave. ★ *Cleveland*, 701 St. Clair Ave., N. E. ★ *Denver*, 4801 Jackson St. ★ *Houston*, 6216 Navigation Blvd. ★ *Los Angeles*, 216 S. Alameda St. ★ *New York*, 19 Rector St. ★ *Philadelphia*, 12 S. Twelfth St. ★ *Portland*, 1032 N. W. 14th Ave. ★ *San Francisco*, 1740 Seventeenth St. ★ *Seattle*, 900 First Avenue S.

Unloaded... Installed... Operating... *in only 48 hours*

Recently a large steel corporation in Kansas City, Mo., ordered this nine-frame, 600 volt I-T-E secondary distribution switchboard as part of a modernization program to replace obsolete distribution equipment and provide additional interrupting capacity.

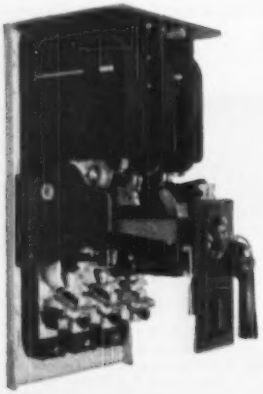
A quick changeover was essential . . .

Shortly after the switchboard arrived at a Kansas City freight yard, it was unloaded from the flat car and transferred by truck to the switchhouse, positioned relative to points of cable entry, main connections were made, and the power switch thrown—*all within 48 hours!*

This switchboard was installed easily, quickly and economically because it was *completely assembled* and *thoroughly tested* at the I-T-E factory prior to shipment. I-T-E engineered the job, supplied all components, installed all internal wiring, shipped the board as a complete unit. Only external cable connections were required after installation.

Here's proof that *you* can modernize *your* plant easily, quickly and economically. And there are many other benefits you get with I-T-E Low Voltage Switchgear. Here are a few:

- **CAREFUL APPLICATION:** I-T-E application engineers carefully apply the equipment to your needs and see that it is built to fit your requirements. All components that go into I-T-E switchboards are the finest obtainable, carefully coordinated into efficient functional units.
- **ATTRACTIVE APPEARANCE:** When you purchase other equipment you select it partly for appearance because you know how important it is to the efficiency of your personnel. Your plant personnel will react just as favorably to more attractive switchgear.
- **DEPENDABLE CIRCUIT BREAKERS:** No switchboard can be more dependable than the circuit breakers in it. I-T-E circuit breakers offer you the trouble-free protection so important to proper plant operation.



◀ *Positive-acting Air Circuit Breakers*

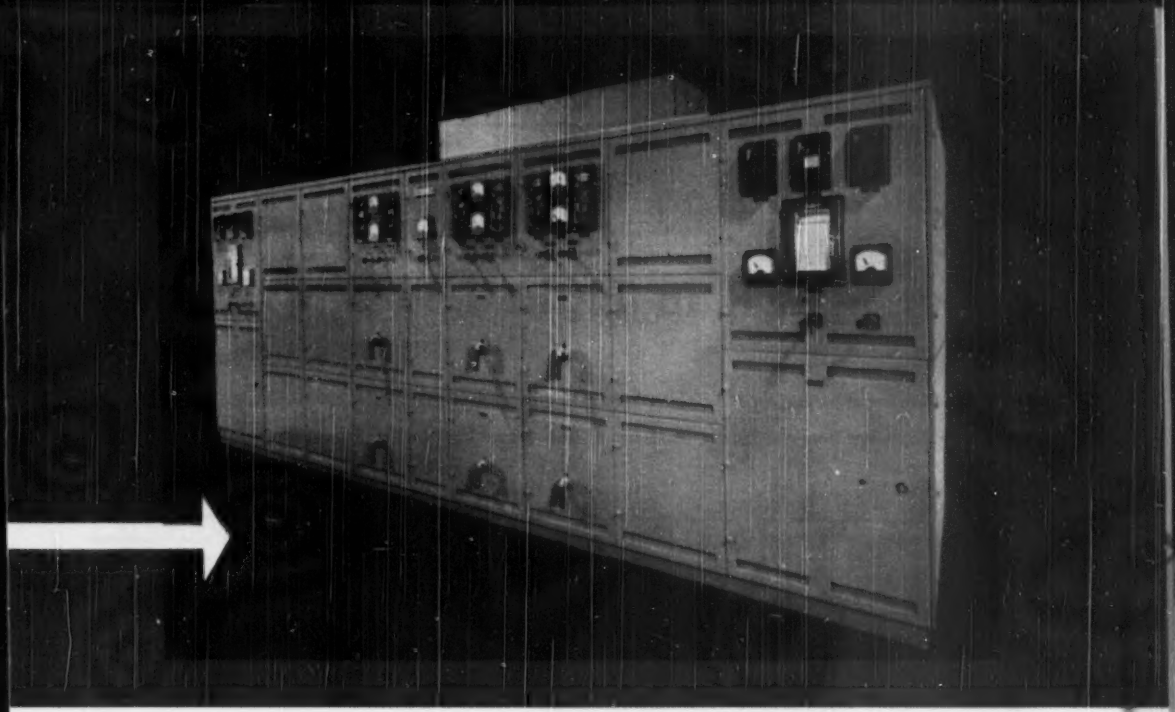
Type KB Breaker. 25,000 RMS Amp. Interrupting Rating. 600 Amp. Continuous Rating. 2, 3, or 4 Poles. Manually or Electrically operated.

Send for these descriptive bulletins: ▶

BULLETIN 6003-D: A complete reference guide to I-T-E 600 V. Switchgear Assemblies.

BULLETIN 7000-A: Describes I-T-E's newest 5 KV Switchgear.

Get both bulletins—ask your local I-T-E Representative, or write I-T-E General Offices.

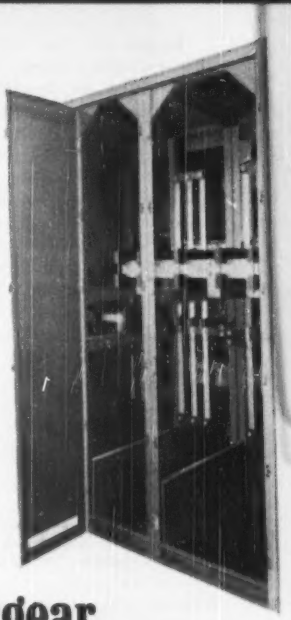


MULTUMITE SWITCHGEAR IS COMPACT . . . EFFICIENT!

The compactness of I-T-E Multumite assemblies is well illustrated in the above photo. Behind the attractive exterior of this switchboard are strong, efficient breakers and components—designed and built to provide positive protection of secondary distribution systems.

Electrically welded steel frames—one for each vertical group of breakers—are bolted together on a continuous channel-iron sill (furnished by I-T-E) to make a strong, rigid, and self-supporting structure. In addition to keeping the switchboard rigid in transit, the sill provides an excellent vermin-proof base for installation.

For extra protection of equipment, each breaker is in a separate metal compartment formed by horizontal and vertical steel barriers welded to the frame, exterior metal panels, and the metal back of breaker itself.



This bus compartment is designed for easy access ▶

Here's another reason installation of I-T-E Low Voltage Switchgear is so easy. A spacious bus compartment with a single horizontal bus facilitates cable connections, makes them easy to get to, provides more space for outgoing cables. Full-height hinged doors swing wide, can be removed easily. The whole compartment is *planned* for maximum accessibility and greater convenience!

I-T-E

R&IE

For *more dependable* Switchgear

specify I-T-E!

I-T-E Circuit Breaker Company • 19th & Hamilton Streets • Philadelphia 30, Pa.

Power Switching Equipment: Railway and Industrial Engineering Co., Greensburg, Pa.

Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS • RESISTORS • SPECIAL PRODUCTS

Sag and Tension for Rural Lines

Copper, ACSR in Light Loading Area

Data are presented for two sizes of bare hard drawn copper and ACSR conductors; an adaptation from distribution standards of Gulf States Utilities Co, Beaumont, Texas

Maximum Tension Loaded 30 deg, 9 lb Wind

No. 6 BHD Copper—545 lb No. 4 ACSR—800 lb
No. 4 BHD Copper—775 lb No. 2 ACSR—1160 lb

Use these figures for calculating guy loads.

Figures given in Table I and II, based on 400 ft ruling span for BHD copper and 500 ft ruling span for ACSR, are for stringing new wire and are called "Initial Sags and Tensions," except that the last column gives sags and tension at 60 deg after it has been loaded, which are called "Design Sags and Tensions."

Maximum tension under loaded condition does not exceed 50% of ultimate wire strength.

Governing condition— 25% maximum strength at 60 deg (for BHD copper), final sag, and 30 deg (for ACSR), final sag, no ice, no wind.

For accuracy on long span construction, use spans and sags below dotted line when stringing wire by the tables at right.

Maximum Level Ground Span on 35 ft Poles 18 ft Minimum Ground Clearance

Primary and Neutral only	
No. 6 and 4 BHD Copper	450 ft
No. 4 and 2 ACSR	525 ft
Primary, Neutral and 1 or 2 Secondaries	
No. 6 and 4 BHD Copper	365 ft
No. 4 and 2 ACSR	420 ft

TABLE I—Sags and Tensions for No. 6 and No. 4 Bare Hard Drawn Copper Conductors

Span Length, ft	SAG (in.) At Temperature (Deg F)										
	30	40	50	60	70	80	90	100	110	120	60 Final
200	12.5	13.0	14.0	14.5	15.0	16.0	16.5	17.5	18.0	19.0	15.0
225	16.0	16.5	17.5	18.5	19.0	20.0	21.0	22.0	23.0	24.0	19.0
250	19.5	20.5	21.5	22.5	23.5	24.0	25.5	27.0	28.0	29.5	23.5
275	24.0	25.0	26.5	27.5	29.0	30.0	31.5	33.0	34.5	36.0	29.0
300	28.5	30.0	31.5	33.0	34.5	36.0	37.5	39.5	41.0	43.0	34.0
325	33.5	35.5	37.0	39.0	40.5	42.5	44.0	46.5	48.5	51.0	40.5
350	39.0	41.0	43.0	45.0	47.0	49.0	51.0	53.5	56.0	59.0	47.0
375	44.5	47.0	49.0	51.5	54.0	56.0	58.5	61.5	64.5	67.5	54.0
400	51.0	53.5	56.0	58.5	61.5	64.0	66.5	70.0	73.5	77.0	61.5
425	57.0	60.0	63.0	66.0	69.0	72.0	75.0	79.0	82.5	86.5	69.0
450	64.0	67.0	70.5	74.0	77.0	80.5	84.0	88.5	92.5	97.0	77.0
Conductor	TENSION (lb)										
No. 6 BHD	405	385	367	350	335	320	305	291	278	266	320
No. 4 BHD	600	573	548	520	500	478	455	435	418	400	492

TABLE II—Sags and Tensions for No. 4 and No. 2 ACSR (6 Al/ str.) Conductors

Span Length, ft	SAG (in.) At Temperature (Deg. F)										
	30	40	50	60	70	80	90	100	110	120	60 Final
300	15.5	16.5	17.5	18.5	20.0	21.5	22.5	24.5	26.0	28.0	22.5
325	18.0	19.0	20.5	21.5	23.5	25.0	26.5	28.5	30.5	33.0	26.0
350	21.0	22.0	23.5	25.0	27.0	29.0	31.0	33.0	35.5	38.0	30.5
375	24.0	25.5	27.0	29.0	31.0	33.0	35.5	38.0	41.0	43.5	35.0
400	27.5	29.0	31.0	33.0	35.5	37.5	40.5	43.5	46.5	49.5	40.0
425	31.0	33.0	35.0	37.0	40.0	42.5	45.5	49.0	52.5	56.0	45.0
450	35.0	37.0	39.0	41.5	45.0	48.0	51.0	55.0	59.0	63.0	50.5
475	39.0	41.0	43.5	46.5	50.0	53.0	56.5	61.0	65.5	70.0	56.0
500	43.2	45.5	48.3	51.6	55.4	59.0	63.0	67.7	72.8	78.0	62.4
525	47.5	50.0	53.0	57.0	61.0	65.0	69.5	74.5	80.0	86.0	68.5
550	52.0	55.0	58.5	62.5	67.0	71.5	76.0	82.0	88.0	94.5	75.5
Conductor	TENSION (lb)										
No. 2 ACSR	800	756	713	670	630	595	545	510	474	445	555
No. 4 ACSR	500	480	450	420	390	360	340	320	300	280	350

Future secondary of No. 6 and No. 4 BHD copper may be strung in any span up to 450 ft by setting intermediate poles to reduce length to not over 365 ft; for No. 4 and No. 2 ACSR the values are 525 ft and 420 ft, respectively, as listed in the foregoing table.

HI-TENSION NEWS *Junior*

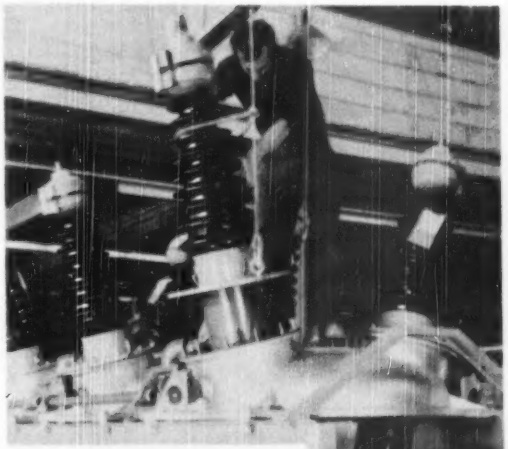
O-B BUSHINGS

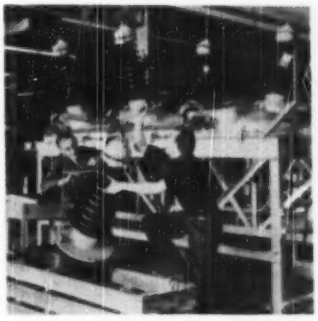
ONE OF THE FINEST COMPONENTS OF ANY CIRCUIT BREAKER

Respect for the high value of a bushing is well demonstrated by a comment recently received from an official of Pacific Electric Manufacturing Corporation: "The insulating bushing is such an important part of a high voltage circuit breaker that it deserves only the best of handling on the erection floor. Our practice is to bring the bushing, in its unopened factory crate, directly alongside the circuit breaker in which it is to be installed. By use of a special rigging, an overhead crane then lifts the bushing and lowers it gently into place, guided by two skilled men. All factory inspection tags are left on the bushings so the user will receive them exactly as shipped from the manufacturer."

It is significant that an apparatus builder who makes such a definite point of the importance of bushings on his equipment is likewise one of the largest and most consistent O-B bushing users. And it is perfectly obvious that, while bushings don't make the equipment, a piece of apparatus is no better than the bushings put there to serve it.

This attitude of an independent, capable manufacturer may suggest the wisdom of specifying O-B bushings on your own station equipment.





Ohio Brass

MANSFIELD, OHIO, U. S. A.

HI-TENSION NEWS *Junior*

How to *Keep* the service you once bought in Switch Insulators

These O-B switch insulators looked just like any other insulator when new—they specified the same—maybe someone even thought *they were just the same.* That was in 1927!

Twenty-three years later these O-B insulators still retain their original ability to serve this substation with complete satisfaction.

In buying switch insulators, it isn't so much what you get as what you *keep!* Standards assure you that, in new insulators of any reputable make, you get the same. These standards can't assure you of an insulator's "staying power," however. Here, you rely upon the past record and integrity of the manufacturer.

If you want to *keep* the satisfaction you originally bought, and keep it for the longest time, operating facts prove the soundness of making O-B your first insulator choice.

This line has helped make O-B the CHOICE OF INSULATORS by *Two* Power Companies

Two metropolitan systems have been tied together by this 132-kv line since 1919. In these 31 years, and in a territory where storm frequency is above average, the performance of O-B insulation has justified this result—both systems that this line connects are consistent users of O-B suspension insulators on the extensive transmission networks they separately operate.

Mere claims tend to evaporate in a time as long as 31 years. When these two properties buy O-B insulators, they now buy them on facts—*their own facts!*

Be guided by men who know that time will ultimately prove beyond question that, for downright reliability, O-B is the first choice of insulators.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

HI-TENSION NEWS *Junior*

PICK THE POST YOU WANT
—It's Here!

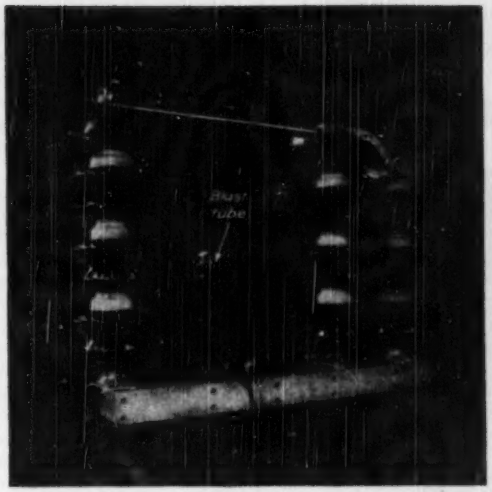
O-B's tradition of fine manufacture and realistic testing, backed by post experience extending to the early days of this class of insulation, is embodied in the present complete listing of posts, found in your O-B catalog.

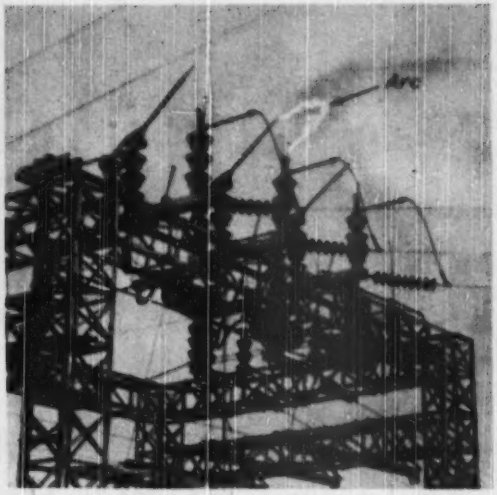
Are all these O-B posts on your purchasing standards? Be sure of this in order to avail yourself of O-B's reputation for building the best in *any* insulation.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

3040





BLAST TUBE mounted on 110-kv air break switch (left) directs gas blast toward arc to hasten interruption. Petticoated tube plus air gap has values of flashover and impulse voltages equal to those of stack. During field tests (right) on 43 miles of 110-kv line, gas blast was used on outside phases but not on center phase. Absence of arcs on outside phases illustrates effectiveness of blast tubes

Gas Blast Interrupts Are On Air Breaker Switch

S. C. KILLIAN
Chief Engineer
Delta-Star Electric Co

FOR INTERRUPTING relatively small currents at 110 kv and above, a gas blast device, mounted on a standard air break switch, extinguishes the arc before the switch is fully opened. The blast device is essentially an insulated porcelain tube which directs air or nitrogen, compressed to 110 psi, toward the switch contacts at a predetermined time.

In operation, as the air switch (hand or motor operated) opens, cam-actuated valves open at the correct time to admit gas into the blast tube. Before the switch reaches its fully open position, the valves reclose to conserve the gas supply.

The blast tube is located below live parts to limit potential on the tube. The air gap in series with the petticoated tube gives a wet flashover value equal to that of the stack. Dry flashover and impulse values also equal those of the stack.

A spring-mounted hinged cover at the orifice of the tube prevents the entrance of dirt and moisture but does not interfere with the gas blast. For 115- and 161-kv switches, a gas velocity in excess of 5,000 fpm persisted with only little decrement in a circle of about 9 in. in diameter at the arc. It is reported that even a very high wind would not deflect the gas stream enough to make it ineffective.

The device has been field tested principally to interrupt line charging currents. In tests made at 110 kv, lengths of line up to 43 miles were dropped without difficulty, the charging current being about 17 amp. During interruptions made without the gas blast, arc rupture never occurred until the switch blade was fully open or almost fully open, and arcs of 30 and 40 ft appeared.

Tests were also made on 134-kv installations. Lengths of line up to 50 miles were dropped without experiencing difficulty in any of the interruptions. At 134 kv the charging current on 50 miles of line is about 21 amp. Loop interruptions were also made without difficulty. Phase spacing was 16 ft.

Based on a paper presented before the annual Midwest Power Conference, and sponsored by the Illinois Institute of Technology, in April, 1950.

Guides for Proper Selection of Coals

THOMAS F. DOWNING
Philadelphia Electric Co.
Philadelphia

TO INSURE that all coals received are within contract specifications, Philadephia Electric Co has developed a set of guides which cover standards and sources of coal, contracts, coal evaluation and policing of samples. These guides apply to all coal-burning equipment, which includes underfeed stokers, slag tap or dry bottom furnaces, a hand-fired low-setting steam heat plant and by-product ovens for producing gas and coke.

Daily records of input, output and coal analyses have been taken for a long period of time. From this data and direct costs which can be estimated, it is decided which available coal characteristics are best for the purpose intended. Factors used in steam generating standards are soften-

ing and liquid ash fusion temperatures, moisture, ash, sulphur, Btu/lb and grindability. Volatile matter is a factor in some plants but it is not included in the standards. Grindability is not included in the standard for stoker coal. Requirements for coke oven coal include gas yield and coke structure. These standards are the basis for evaluation.

Sources

Tributary coal fields of Pennsylvania and northern West Virginia contain coals suitable for all company uses. General knowledge of each coal seam of every producing district is valuable. In considering a new shipper, the mine is inspected. The intelligent combining of analytic results of face samples, mining conditions and preparation facilities gives a fair indication of the quality which can be shipped. It also indicates the proper coal use. Reliability of the shipper and remaining coal reserves also are considered. Periodic visits to mines and personal contact with the local mine management are both recommended.

Contracts

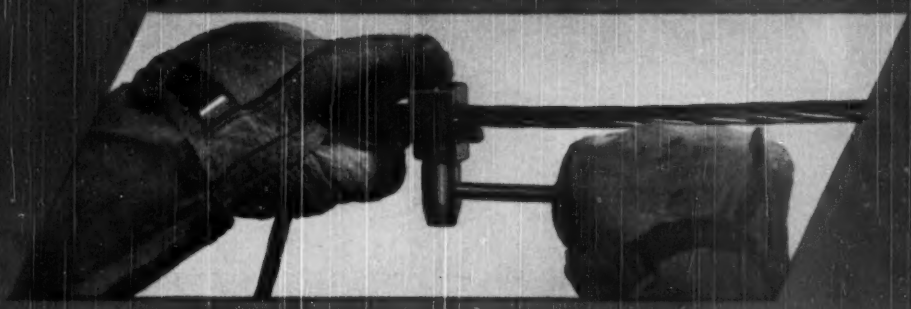
The purchasing department is supplied with specifications which it is believed individual mines can meet. These are based on past performance and any knowledge of changed mining conditions or added equipment which may influence quality. After specifications are agreed to by the prospective vendors, they are written into the contract. Prior to contracting, the purchasing department is also given the value of coal from each mine. This value is based on suggested specifications applied to standards at a specified delivered cost.

Most of the generating station coal is delivered in barges. Each barge is sampled throughout its unloading. Every 1,000 net tons of rail coal are sampled. At the end of each month, analyses of each coal are averaged. Cost to the company for each coal is obtained by calculating divergences from standards.

When monthly calculated cost of a coal exceeds estimated cost on contracted specifications, the weekly order may be reduced until coal quality returns to expected limits, or all shipments may be suspended. In such cases, the vendor is advised of the reason for curtailment of order.

As soon as an analysis which is

Easy to Handle



FARGO CONNECTORS*

Hold Wires Permanently!

Preferred by Linemen for their ease of installation—Fargo Connectors are built on the same principle as the ordinary bench vise . . . with the same high mechanical efficiency for converting a torsional force into a compressive one—*so they hold permanently!* They make a vibration-proof contact . . . require no attention after installation—and provide an ideal, low-resistance connection at a cost no more than other types.

. . . "built like a vise —grips like a vise."

EASY TO USE

—because of the "one-piece" design that means no threads to clean—no loose parts to lose.

*Approved by Underwriters' Laboratories, Inc.

Fargo distribution Connectors are available in lap jaw, straight jaw, diagonal jaw and spacer-bar types. Also, there are Fargo Connectors for transmission and heavy-duty distribution installations. Your Line Material Field Engineer will be glad to give you complete details on these, as well as other time and labor saving devices in the Fargo line.

FARGO

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, N.Y.

Distributed by
LINE MATERIAL COMPANY
Milwaukee, Wisconsin

the troffer it took

10 years to build!

Guth LITE-BLOX

the ONE answer to every troffer need

From 10 years' experience with thousands of recessed troffer problems comes this dynamic development — a complete new "packaged" line that is far more . . .

ADAPTABLE!

- "Hand-Crafted" appearance with tailored trim
- Infinite design freedom — any pattern based on 12" grid
- 20 sizes of popular standard and slimline lamps
- Wide range of diffusing and shielding media

STOCKABLE!

- One basic unit for 31,360 troffer combinations
- Simplified ordering — one number for a complete row
- Flange types on hand can be quickly converted to teebar—or vice versa

INSTALLABLE!

- Complete units ready to install — no joiners
- Precision built on advanced-type machinery — easy to align
- Patented end KO's assure accurate foot-lengths — no trimming at end of rows

For full details call your nearest GUTH resident engineer or write for Bulletin 869-H

Guth LIGHTING

399

THE EDWIN F. GUTH COMPANY • ST. LOUIS 3, MISSOURI

Leaders in Lighting Since 1902

out of line with contract specifications is received, the vendor is given the results by telephone. If subsequent deliveries continue out of line, shipments are curtailed or suspended. A field examination indicates whether the lapse was temporary or whether other arrangements should be made.

•

MAXIMUM FLEXIBILITY is obtained from meter racks above since cross members can be adjusted up or down and meters can be moved to any position on cross member

Meter Racks Built For Flexibility

V. M. SPRANGEL
Meter Superintendent,
Public Service Company of Oklahoma
Tulsa

METER RACKS with maximum flexibility and convenience have been fabricated in Public Service Company of Oklahoma's meter shop from Unistrut metal framing. The all-purpose framing is similar to conventional construction channel iron but has a lip on each side to permit vertical adjustment of the horizontal bars and horizontal adjustment of the meter hooks. Horizontal channels can be moved up or down, sliding in the slot of vertical channels, to any desired position. Meter hooks can be moved to any position by sliding them along the slots of the horizontal channels.

A patented nut which tightens to the shoulders of the iron forms a sturdy metal rack. No holes have to be bored into the iron. This makes the racks entirely flexible as to size

Your order reached our office as the clock struck 8 A.M.

It was entered and a messenger delivered it to our Production Department (under the same roof).

Production checks with Warehouse (under the same roof) to see if the product is in stock. If it is in stock, your material moves promptly from Warehouse to Shipping Department (under the same roof).

If the material ordered is NOT in stock, our Manufacturing Department (under the same roof) immediately starts the wheels to produce your order.

YOUR ORDER IS ON THE WAY

And by the clock on the office wall, it is 8:15 A.M. (YES, SIR! THAT SAME DAY!)

OUR ACSR CONDUCTORS are built to highest specifications, laboratory-tested, and are immediately available in 4 ga. to 2,000,000 Cir. Mils.

BARE COPPER WIRES AND CABLES—A full range of sizes from 14 ga. solid to standard strandings up to 2,000,000 Cir. Mils available for prompt shipment.

WEATHERPROOF COPPER WIRE is also stocked to make complete mixture of distribution line material available in one shipment.

GALVANIZED STEEL STRAND, highest quality, manufactured and stored in all grades, sizes and construction, shipped in coils or reels.

ACSR ACCESSORIES—We maintain large stocks for immediate shipment with Conductors. A complete assortment of sizes on Armor Rods, straight and preformed; Twisting Joints, Tie Wires, Flat Aluminum Tape, Clips, Clamps and Dead Ends is available.

OUR OWN TRUCKS DELIVER, ANYWHERE IN THE SOUTHEAST, WITHIN 48 HOURS.

SOUTHERN QUALITY
meets every test

PHONE 7-3325

SOUTHERN SERVICE
excels the rest

WRITE P. O. BOX 989

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Southern Electrical Corporation

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Your Best Protection

FOR FLAMMABLE LIQUID AND ELECTRICAL FIRES

TRANSIL OIL
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CIRCUIT BREAKERS
MOTORS, ETC.

ANSUL

DRY CHEMICAL

FIRE EXTINGUISHERS

They're most dependable too! Years of field service protecting all kinds of Electrical Equipment has resulted in outstanding design features available ONLY in Ansul Dry Chemical Extinguishers.

FIRE PROTECTION by the dry chemical method has proved *Most Effective* as well as *Most Economical*. And only Ansul offers a complete line of hand, wheeled and stationary dry chemical fire extinguishers. Investigate Ansul Piped Systems for protection of special hazards.

Send for File No. 509. You will receive a variety of helpful printed matter. Included is our latest catalog which describes Ansul Extinguishers of all sizes — from the small Ansul Model 4 to Ansul Piped Systems and Ansul 2000 lb. Stationary Units.

ADVANTAGES

1. Quick, Positive Extinguishing Action.
2. Easier on the Spot Recharge (No special tools needed).
3. No Annual Recharge Necessary.
4. Low Maintenance Costs.
5. ANSUL PLUS-FIFTY Dry Chemical used Exclusively.
6. Long Range Stream.
7. Effective in Winds and Drafts.
8. Stream pattern forms heat shielding screen to protect operator.
9. Listed and Approved by Underwriters' Laboratories, Inc., and Factory Mutual Laboratories.

PIONEERS OF DRY CHEMICAL

ANSUL

ANSUL CHEMICAL COMPANY

FIRE EXTINGUISHER DIVISION, MARINETTE, WISCONSIN

and variable as to hooks for different size meters. Metal hooks, made in a local supply house, provide hangers for the meters.

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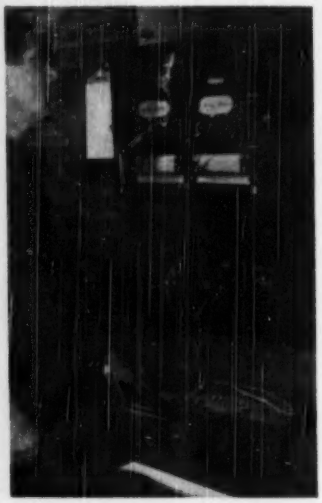

TEST-SET assembled by Toledo Edison Co for applying 240-v ground test to every meter. Graphic watthour meters may be checked for proper connections by applying a 100% or a 50% power factor load

Checks and Rechecks Improve Meter Testing

P. R. KNAPP
General Supt
Toledo Edison Co

A UNIT has been added to all test tables of the Toledo Edison Co whereby every meter is submitted to a 240-v ground test (see illustration). This is done not to test coil insulation but to locate a ground or short on the meter base that would cause trouble when the meter was connected to the socket.

A socket has been added to all test tables to prove that meters run after testing. This eliminates complaints of "dead" meters at monthly reading time. A bank of sockets has been wired on a temporary board to give time-switch "hot water" meters a time run. This method shows up troubles faster than any other way.

Spring-wound clocks have been replaced with motor-driven clocks on graphic watthour meters. This enables two or more graphic meters to indicate on charts the maximum demands simultaneously.

FOR YOU *free*

YOUR 1950-51 GUIDE TO SERVICE PLUS WITH OUR LATEST WAREHOUSE PRICES AND EXTRAS

Complete list of available stock

Important reference charts and tables

Colored sections for special products

22 tabs for quick product reference

Easy to read Easy to use

A "must" for every steel buyer!

● Our new '50-'51 Stock List and Reference Book is a necessary and valuable tool for every steel user. Principally, it contains a complete listing of readily available stocks of steel, aluminum, tools, equipment and machinery. In addition, it now contains facilities for easy computation of *up-to-the-minute prices*. Colored sections for special products, finger tabs for principal items, and a complete alphabetical index are only a few of the features that make it easy for you to use.

If you want "Service Plus," you'll want this book on your desk all year. Fill in and mail the attached coupon at once.

Mail coupon today!

United States Steel Supply Company
208 S. La Salle Street
Chicago 4, Illinois

Gentlemen: Please send me, without obligation, a copy of your 1950-51 Stock List and Reference Book. I am attaching one of my company letterheads.

Name.....

Title.....

Firm.....

City.....State.....

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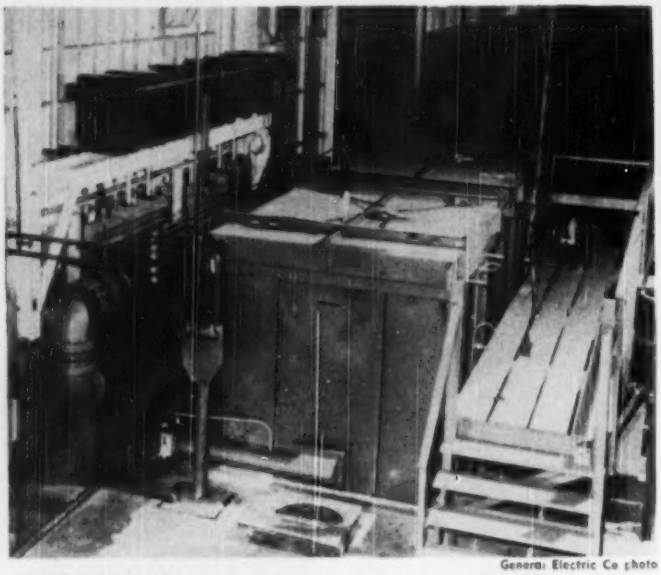
UNITED STATES STEEL SUPPLY COMPANY

Warehouses and Sales Offices: BALTIMORE · BOSTON · CHICAGO
CLEVELAND · LOS ANGELES · MILWAUKEE · MOLINE, ILL. · NEWARK · PITTSBURGH
PORTLAND, ORE. · SAN FRANCISCO · SEATTLE · ST. LOUIS · TWIN CITY (ST. PAUL)
Sales Offices: KANSAS CITY, MO. · PHILADELPHIA · ROCKFORD, ILL. · TOLEDO · TULSA · YOUNGSTOWN
Headquarters Offices: 208 S. La Salle St.—Chicago 4, Ill.

UNITED STATES STEEL



General Electric Co photo

ELECTRIC FURNACES anneal stainless steel jet engine aft-frames. The two box-type furnaces, each rated 135 kw, have carefully controlled annealing cycle which relieves stresses

Electric Furnaces Improve Stainless Steel Annealing

TWO BOX-TYPE electric furnaces, rated at 135 kw, have recently been installed at the Solar Aircraft Co in San Diego, Calif., for annealing aft-frames of aircraft turbo-jet engines. These furnaces are capable of annealing four frames at once, two to a furnace. They operate with a protective atmosphere and have a carefully controlled annealing cycle which relieves stresses within the metal work of the stainless steel frames.

The furnaces are situated side by side and are so arranged that either furnace can be charged by lifting the furnace lid with a hoist and depositing it on top of the adjacent furnace. Then the frames are placed into the furnace by means of the hoist and the furnace cover replaced.

An atmosphere gas converter supplies a protective atmosphere of carbon dioxide, nitrogen, carbon monoxide, and a small quantity of hydrogen. The air-gas ratio is adjusted to produce a neutral mixture for purging the furnaces at the beginning and end of each cycle. Ribbon resistors, supported on the walls of the furnace casing, provide radiant heat to bring the equipment up to the proper temperature. Protective atmosphere circulating cooling systems built integral with each furnace permit forced but regulated cooling after the heating cycle is completed.

The frames are put in the furnaces and removed from them at a temperature below 500 F; thus the material is completely stress relieved, without objectionable oxidation. The heat treating cycle consists of heating the material to 1,650 F at the rate of 100 F per hr and holding the material at 1,650 F for a period of three hours. At the end of this time, the power input to the furnace is shut off and the atmosphere gas cooler cools the furnace at the rate of 200 F per hr to a temperature of 500 F.

The heat treating cycle is carefully controlled by special program-type instrument controllers which can be set to give a wide range of predetermined rates on increase and decrease in furnace temperature. Once the program has been established for the desired type of heat treatment, the instrument controllers automatically repeat this cycle.

"Home Cooler Promotion" Proves Value of Planning

W. S. BASCOM
Union Electric Company of Missouri
St. Louis

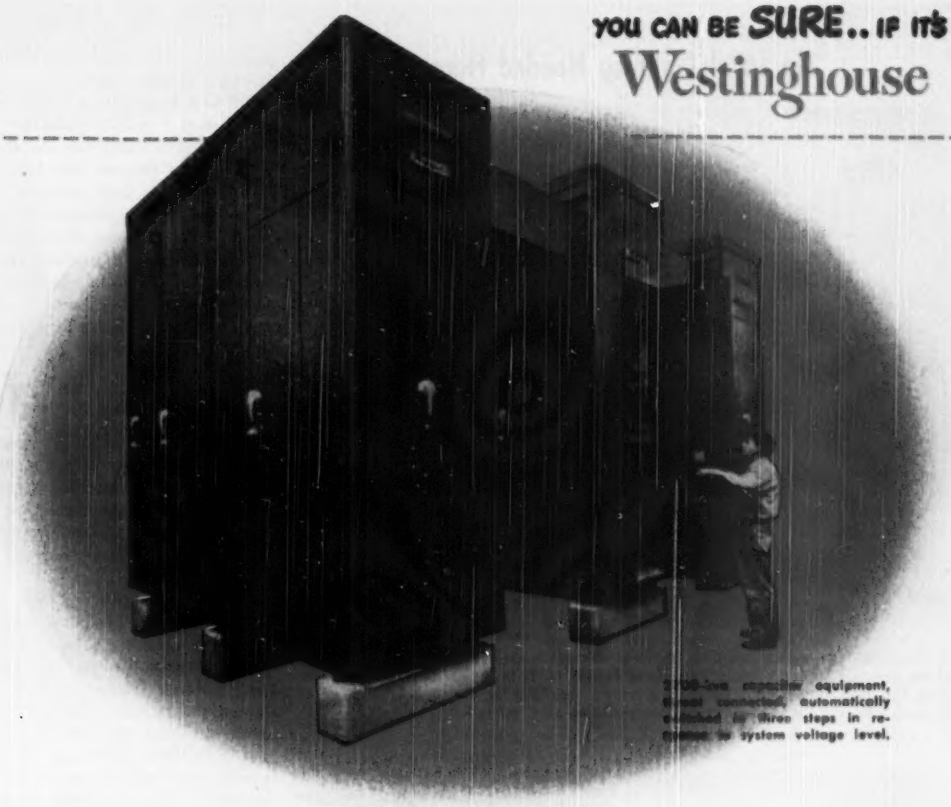
A YEAR AGO, Herb Cummings, advertising manager of Sears' St. Louis group of stores, decided it was high time to persuade people to stop talking about the weather and do something about it. A direct mail campaign on home coolers was expertly planned to convince some 26,000 rural customers that the "good ole' summertime" could be just that with an easy-to-install home cooler.

A certificate worth $3.00 on the purchase of a home cooler prior to July 1, 1949, was imprinted on the letter. That was in March, last year.

When the fan weather hit St. Louis in the latter part of June, Sears' three St. Louis stores were "snowed" under with customers seeking window fans. A local newspaper printed a front page picture of the throngs jamming Sears' stores to obtain home coolers. Salesmen were writing orders and delivering the merchandise right off the delivery trucks.

Over 10,000 coolers were sold during this period and approximately one-fourth of the purchasers turned in $3.00 certificates which they had received in March. Ten percent of the families reached in the campaign purchased home coolers.

YOU CAN BE **SURE**.. IF IT'S
Westinghouse



2100-kva capacitor equipment, shunt connected, automatically switched in three steps in response to system voltage level.

WESTINGHOUSE HOUSED CAPACITOR UNITS

Keep Voltage—AND COSTS—in line!

You can be *sure* of dependable voltage control with Westinghouse Housed Capacitor equipment. You can be *sure* about savings too, because the Westinghouse unit is designed to trim your substation costs. For example . . .

A compact design allows for smaller substation space . . . lower real estate costs.

Factory assembly assures low installation costs. You need only mount the housing on pads, set capacitor units in place, and make primary connections.

Complete interlocking assures safety to personnel—shorting and grounding the capacitors before housing can be entered.

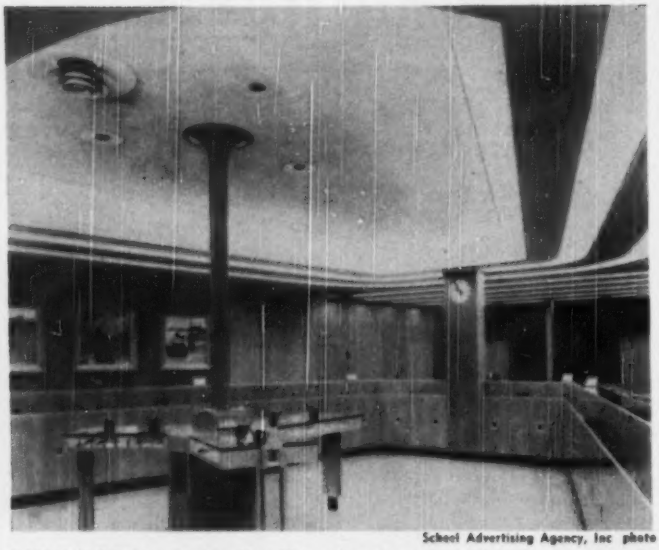
A self-contained design saves the cost of installing external accessories.

Savings like these are supplemented by extra revenue when good voltage control is maintained at the substation. And Westinghouse housed equipment with built-in automatic control—responsive to line voltage, load current or kva load—assures the finest.

For complete information on Westinghouse Inerteen Capacitors, write for Booklet B-4343. Address: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-60723

Westinghouse
CAPACITORS

No Local Lighting Needed Here



School Advertising Agency, Inc photo

ILLUMINATION varying from 85 to 25 ft-c eliminates any need for local lights in a branch of the Manufacturers and Traders Trust Co of Buffalo, N. Y. Iridescent glass panels prevent glare from the parallel lines of ceiling-flush troffers. The 1,824 lin ft of 25 mm cold cathode luminous tubes constitute a load of 13.2 kw, averaging 5.5 w per sq ft

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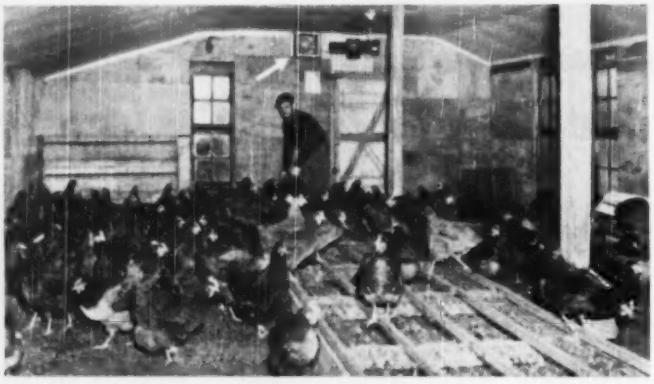


ADEQUATE VENTILATION of this 22 x 42 ft insulated poultry house containing 250 birds, is furnished by an 8-in. fan, visible above the head of the owner, Ezra Aeschliman. Fan capacity is 350 cfm. Temperature outside was 28 F, inside, 43 F, and on the floor, 65 F

Forced Ventilation for Poultry Houses

VIRGIL MARVIN
Toledo Edison Co
Ohio

MECHANICAL VENTILATION of poultry houses presents a relatively new potential for rural load. As a large percentage of the laying flocks are located in the northern states where winter ventilation has been a problem, the application of electricity to this use should be given appropriate consideration.

After observing many practical applications in Northwestern Ohio in the past several years, there is no doubt that a ventilation system using a fan does a more satisfactory job than relying on natural air movement. This is from farmers who have had experience with both methods.

For practical applications to poultry, a wide range of environmental temperatures is allowable. As an example some poultry men say that on the low side, temperatures down to 15 F do not, while on the high side temperatures above 80 F do, affect egg production.

Interdependent Factors

There are a number of interdependent factors governing the rate of ventilation such as building construction, environmental temperature and humidity, outside temperature and humidity, number and breed of birds, and others.

In practical applications the only heat source considered has been the bird itself. However, field observations made recently in poultry houses using built-up litter showed a substantial temperature differential between the litter and the air in the house. No doubt this is due to chemical and biological activity in the litter. This is an important factor in vaporizing the moisture excreted by the birds.

The average winter temperature and relative humidity in northwestern Ohio is about 28 F and 77%. In this territory we have been using 1 to 1½ cfm per 4-lb bird. As the winter temperatures are not severe, we have been able to do a satisfactory job in poultry houses that are sealed but uninsulated. However the most satisfactory installations have proved to be those in conjunction with insulated houses.

Mechanics of the installation are simple. Air intakes are at ceiling height on the wall opposite the exhaust fan. The total square inches of air intake is made to equal the area of the exhaust fan. The intakes are so constructed that they may be adjusted from open to closed position.

The cost for equipment to provide mechanical ventilation for a building housing 300 birds would range from $12 to $25 depending upon the particular fan purchased. The energy use per year will vary from 100 to 300 kwhr.

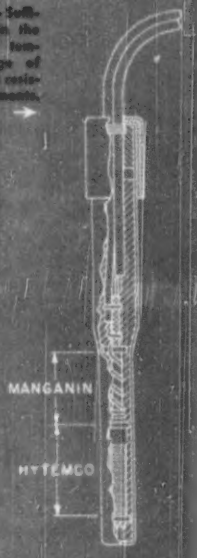
High-Accuracy Beckman pH Meter† relies on D-H ALLOYS

FLOW CHAMBER — with resistance bulb thermometer and electrodes.
BECKMAN MODEL R pH INDICATOR containing amplifier and precision measuring circuits.

In large industrial installations, where pH control must be continuous or automatic, or both, the temperature of process solutions has to be obtained continuously, in order to compensate for effects of temperature change upon pH.

To accomplish this, the Beckman Model R Automatic pH Indicator provides a flow chamber, or immersion assembly, containing a resistance bulb thermometer in addition to the glass and calomel electrodes used in measuring pH. This resistance thermometer is an element in the feed-back circuit of a stable DC amplifier whose sensitivity is accordingly varied in proportion to the absolute temperature of the process solution.

To assure complete accuracy, the thermometer of the Beckman Model R pH Indicator is wound with D-H HYTEMCO* wire, supplemented with D-H MANGANIN. The high temperature coefficient of HYTEMCO makes it eminently suitable for this application; and the absolutely uniform behavior of this alloy, thruout a wide temperature range, helps the indicator to record pH values with utmost fidelity. The supplementary winding of D-H MANGANIN is required in order to raise the resistance of the assembly to a specific circuit value without increasing the increment of resistance with temperature. This the MANGANIN does very effectively.



RESISTANCE BULB THERMOMETER — Sufficient Hytemco wire is used to obtain the necessary resistance value for the temperature range. A small percentage of Manganin is then added to bring total resistance of winding up to circuit requirements.

In addition to the desirable electrical characteristics of these D-H alloys, however, is the outstanding uniformity of the wire from spool to spool, and the quality "built into" it —as a result of exclusive Driver-Harris know-how and advanced melting, rolling and drawing techniques.

Special alloys for special uses is an important phase of our business. If you have been unable to obtain just what you are looking for, let us know your requirements. We'll gladly put our 50 years of experience at your disposal, and supply you with the alloy best suited to your needs.

†Product of National Technical Laboratories, S. Pasadena, Calif.

Makers of world-famous Nichrome and over 80 alloys for the electrical, electronic and heat-treating fields*

Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

Manufactured and sold in Canada by
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

FIFTIETH ANNIVERSARY

*T. M. Reg. U. S. Pat. Off.

Now!!! Aluminum Alloys and Stainless Steel

are combined for still more years of trouble free servicing with

THOMPSON DISCONNECTING AND LOWERING HANGERS

New Thompson Aluminum Unit Package. Never before so light, so strong, so resistant to corrosive atmosphere and weathering.

New Unit Packages provide for open vertical chain as illustrated, or enclosure in ¾" conduit for complete protection from weather and tampering.

New VR Adapter for bail or yoke suspended floodlights. Assures perfectly balanced support with unbelievable simplicity.

NEW ALUMINUM UNIT PACKAGES

are available for easy, low cost, safe, servicing of threaded pendant hood luminaires, bail or yoke suspended floodlights, aeronautical obstruction lights and 300 MM flasher code beacons.

NEW 1950 CATALOG AVAILABLE. Also new Bulletin, Aeronautical Obstruction Lighting with Thompson Hangers. Request on your Company Letterhead.

THOMPSON
DISCONNECTING & LOWERING
HANGERS

THE THOMPSON ELECTRIC CO.
1101 POWER AVENUE • CLEVELAND 14, OHIO

INDUSTRIAL BRIEFS

Arc Furnace Installation saves on time and cost at Armco Steel Corp, Middletown, Ohio, as compared with open hearth furnaces. Under certain market conditions the price of scrap is such that the electric furnace can compete with the open hearth. Two 70 ton furnaces of Hercult design were installed. Furnaces are producing approx 3.7 heats per day using approx 510 kwhr per short ton of ingot produced. Power input is approx 14,000 kw during melting period and 5,000 kw during the refining period. Each furnace is supplied by 15,000 kva, 3-ph, 60-c, 13,200 to 135 and 290-v transformer—oil insulated and water cooled. Tap changing under load permits voltage adjustment in the range from 135 to 290 v. Suggested by Eric O'Hara, Cincinnati Gas & Electric Co.

Infrared Heats Metal Molds quicker and safer at the George Young Co, Chicago, manufacturers of softballs. Vertical oven, requiring less floor space than the previously-used gas fired oven has four 2,500-w infrared radiant heaters in two groups, mounted facing conveyor chain with metal molds inserted. Safe operating conditions and continuous production—faster than the batch type convection oven are advantageous. This method also permits the use of increased percentage of kapok and less cord resulting in reduced cost and a more lively ball.

R-F Heating Increases Output at the Alexander Wood Products Co, Athens, Ga. Two and one-half times as much material is produced with more uniform results. Twenty-four manhours per day are saved. A 2-kw, 15-mc high frequency quick glue set is used for all $\frac{3}{4}$ in.-thick stock at an average speed of 60 fpm. The normal speed for $\frac{3}{16}$ in. stock is only 20 fpm and a temperature of 425 F is required. With the r-f heat, temperature of 250 F is sufficient.

Par Lamps are installed in the shot-blast room of G. E. Co.'s Erie, Pa., Locomotive Works to replace the formerly-used explosion-proof units that couldn't stand the gaff and frequently were broken. Approx 100 PAR-38 150-w flood lamps are used.

Dependable, Permanent Grounding!

BLACKBURN *Copper-Bonded* GROUND ROD

Completely Covered - - -

Molecularly Bonded to

Steel Core---To Insure

Lasting Protection

Note uniform copper covering, molecularly bonded to steel core. Cross section of copper is greater than No. 4 wire. Both point and driving end completely covered to totally protect steel.

UL

For Your Protection!

Here is a quality ground rod from a reliable mid-western source — a stable, dependable source of supply — a strategically located source for quick shipment to central, southern and western sections of the country.

For your convenience BLACKBURN maintains numerous, conveniently-located jobber stocks, backed up by a large warehouse stock at the factory in St. Louis.

For a dependable source of a truly quality rod specify BLACKBURN when you order.

Distributed on the West Coast by
KORTICK MANUFACTURING CO.

JASPER BLACKBURN PRODUCTS CORP.
FIRST MADISON & CLINTON STS
St. Louis 6, Mo. - Phone CEntral 3007
BUILDERS OF QUALITY PRODUCTS

VISIBILITY UNLIMITED –

WITH PLEXIGLAS QUALITY LIGHTING

A Lighting Fixture As Big As The Room. PLEXIGLAS diffusing panels in control room of Philadelphia Electric Company generating station. Large sections of white translucent PLEXIGLAS, installed wall-to-wall below cold cathode tubes, give excellent glare-free illumination.

Three things happen when you install PLEXIGLAS Lighting Fixtures:—

Glare and eyestrain take a permanent holiday.
Personnel efficiency and morale go kiting.
Lighting maintenance tumbles to a new low.

White translucent PLEXIGLAS diffuses light so completely that glare simply vanishes. Brightness ratios are remarkably low, yet minimum absorption and maximum transmission of light give full, even illumination throughout any room. Maintenance costs are negligible because PLEXIGLAS is light, strong, shatter-

EYESTRAIN ZERO

No Glare—No Shadows. Installed by Texas Electric Service Co., Fort Worth, in their own sales office, this wall-to-wall luminous ceiling gives glare-free, completely diffused illumination throughout the room. Footcandle reading is 99, *with* diffusing panels—110 *without* panels. This remarkable efficiency is possible only because white translucent PLEXIGLAS absorbs no light. Corrugations run in opposite directions in adjoining panels, providing an interesting decorative pattern. Lighted by 66 T12 Slimlines operated at 425 ma and 107 T8 Slimlines operated at 200 ma.

resistant—proof against discoloration from fluorescent lighting.

Because PLEXIGLAS weighs less than half as much as glass, it's easy to install—even in large sections for wall-to-wall luminous ceilings. And because PLEXIGLAS is easily cut, shaped, machined and fabricated, it adapts readily to coffer, cove or trough lighting, completely enclosed units, wall or overhead lighting of all kinds. For full details of PLEXIGLAS Quality Lighting in banks, stores, drafting rooms and classrooms, send for free literature today. There's no obligation.

WRITE FOR THIS FREE LITERATURE TODAY...
and ask any questions you wish about PLEXIGLAS acrylic plastic for lighting.

PLEXIGLAS is a trade-mark, Reg. U.S. Pat. Off. and in principal foreign countries.

CHEMICALS FOR INDUSTRY

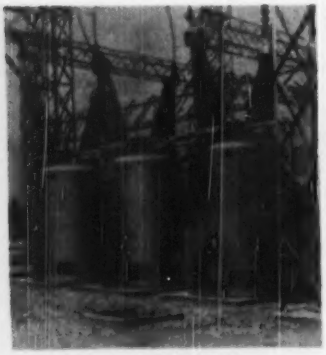
ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Canadian Distributor: Crystal Glass & Plastics, Ltd., 282 St. Helens Avenue, Toronto, Ont.

NEW EQUIPMENT



Oil Circuit Breakers

DESIGNED to conform to highest present day interrupting requirements, the Type RHE circuit breakers have been announced in the voltage ranges from 115 kv to 230 kv with interrupting rating to 5 million kva at 115 and 138 kv, to 7.5 million kva at 161 kv, and to 10 million kva at 230 kv.

Interrupting time is within 3 c after energizing trip coil; closing is within 10 c; reclosing is rated at 20 c, though adjustable in the field from 15 to 45 c. Based on tests at Grand Coulee in June 1948, it is claimed the circuit breaker can interrupt to full rating without apparent distress or jar on foundations.

Entrance bushings are attached to the tanks through adjustable spherical-type metal-to-metal joints. The moving contact structure is the single-unit rotary type, providing six breaks in series per pole. Each blade enters a group of four sliding-shoe contacts, all of which carry load current. Arcing is confined to one contact but not on that surface carrying load.

There are no moving parts within the tank other than the one-piece rotary structure. Closing springs are compressed by oil-hydraulic means operated from motor pump, requiring 10 sec. Should control power fail, the springs may be compressed by hand pump, requiring 2 min. The opening and closing latches embody new developments which, it is reported, prevent disengagement except at proper times.

The circuit breaker is also said to be electrically and mechanically trip-free in any position.

Pacific Electric Manufacturing Corp., 5815 Third St., San Francisco, Calif.

Transformer Ground Pad

COPPER permanently bonded to steel by a special process forms a cladmetal used for ground pads applied to electric power transformers. Advantages of this cladmetal, a copper/SAE 1010 steel combination, are said to include ease of manufacturing where the transformer complies with NEMA specifications in sizes of 167 kva or larger.

A solid ground connection for the life of the transformer results from arc welding the pad to the transformer case. Pads can be cut to size and stocked for future use.

American Cladmetals Co., P.O. Box 544, Carnegie, Pa.

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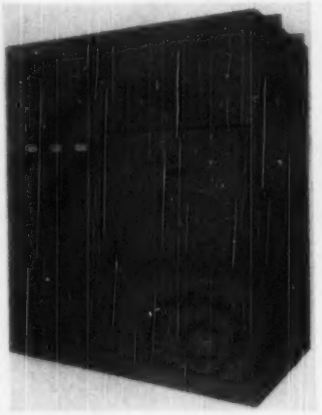
Meter Socket Channel

WATER is kept out of a new meter socket channel, and the meter is protected from condensation, by running the conduit straight down into the side of the meter channel below the terminals. The sealing ring holds the meter, terminal chamber and wiring compartment cover in place. Manufacturer states that nothing else need be removed for wiring, testing, or removing the meter. It is said that no protective devices need be used while the cover is being removed or replaced.

Terminals in the compartment are said to simplify inspection or testing the meter without disrupting the customer's service. Terminals are provided for wire from No. 8 to No. 3/0. Line terminals are the bus type so that the live wire can be run from one socket to another in an open channel without cutting or bending the wire.

The Code Electric Products Corp., 1512 Fox Bldg., Philadelphia 3, Pa.



Synchronous Motor Control

REDUCED-VOLTAGE synchronous motor control units, for operating and protecting synchronous motor drives, are supplied as factory-wired units requiring only external connections.

Line disturbance is said to be minimized by a new Type ASR polarized slip-frequency relay, with associated control. It provides automatic synchronization with maximum pull-in torque at the proper speed and phase relation. Pull-out protection stops the motor automatically although provision for re-synchronization can be made. There is a thermal protective relay in the stator, and another in the rotor damper windings in case of failure to start.

With optional Type BAL fuses, these Slipsyn units have interrupting capacities up to 250,000 kva, 4,800 v, 3-ph, 60 c.

Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.

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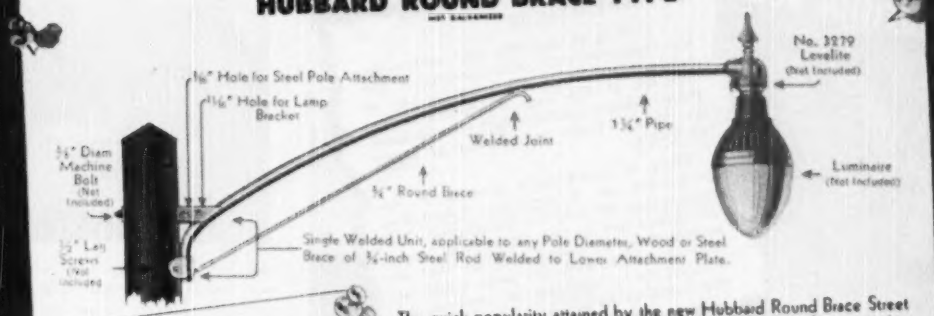
Service Truck

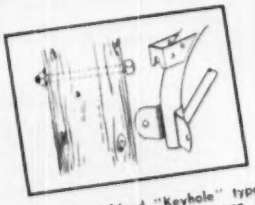
FOR UTILITIES in small communities where dual service is desired, a combination street light and general service truck body with a removable 20-ft extension ladder is available. Special strut bracing is said to have a tripod effect on the ladder.

Welded steel body unit is arranged to carry meters in a special compartment. Also provided are a radio compartment, adjustable shelves, and mate-

THE POPULAR NEW STREET LIGHTING BRACKET

HUBBARD ROUND BRACE TYPE


No. 3279 Levelite (Not Included)
⅝" Hole for Steel Pole Attachment
1⅛" Hole for Lamp Bracket
Welded Joint
1¼" Pipe
⅝" Diam. Machine Bolt (Not Included)
¾" Round Brace
Luminaire (Not Included)
½" Lag Screws (Not Included)
Single Welded Unit, applicable to any Pole Diameter, Wood or Steel. Brace of ¾-inch Steel Rod Welded to Lower Attachment Plate.

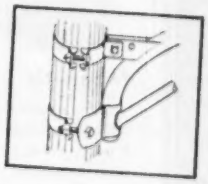


The exclusive Hubbard "Keyhole" type of attachment permits installation by one man. Insert the Machine Bolt in the pole and turn nut down so that the head of the bolt is left projecting about an inch from the pole. Simply "hang" the Bracket over the head of the bolt. Then draw nut tight and install the lags in the bottom plate.

The quick popularity attained by the new Hubbard Round Brace Street Lighting Brackets is easily understood. They have a smooth upsweeping curve that combines appealing grace with practical features of high lift and easy wiring.

Mounting space on the pole, between mounting bolt and lag screws, is only 8⅜-inches, and the actual gross measurement from top to bottom of attachment is less than one foot. This extreme economy of space becomes a most desirable feature where small space is available, or where it is necessary to mount the bracket at the top of the pole to gain luminaire elevation. Attachment plates, ¾-inch round brace, and pipe are welded into one integral unit of great rigidity and strength.

The bracket may be mounted on steel poles . . . simply specify pole diameter, bands and bolts for this purpose. It is furnished with threaded end for Levelite attachment or plain end for slip-fitter luminaires.



For steel pole attachment, there is no change in the design of the arm. Bands are used, constructed to attach to the top fastening of the arm and utilizing two angle bolts to attach to the bottom fastening. For small diameter pole mountings, the "ears" on the lower attachment are drawn in by tightening the nuts until the best fit is obtained.

Stock No.	End	Nominal Length, Feet	Nominal Pipe Size, Inches	Rise—From Top of Lower Attachment Plate to Center of Pipe at Outer End—Approx. Inches	Approx. Shipping Weight Lbs. 100 Pcs.
23206	Threaded	6	1¼	26	3150
23206-P	Plain	6	1¼	26	3150
23208	Threaded	8	1¼	29	3500
23208-P	Plain	8	1¼	29	3500

HUBBARD AND COMPANY

ESTABLISHED 1843

PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the load on Hubbard Hardware!"

NOW! the transformer of the future

ELECTRICAL WORLD

FUTURE POSSIBILITIES

. . . It is to be expected that such activity (improvements) will continue in the future. Much of it can probably not be foreseen at this time. There are a few items, however, which might be mentioned as either distinct possibilities or highly desirable.

There is considerable promise of the production of a dry-type distribution transformer for pole top installation. The advantage will be less weight and lower maintenance. It seems possible that on such a transformer the case might be reduced to a minimum or perhaps be eliminated entirely.

LIGHTER! SMALLER! SAFER! MORE ECONOMICAL!

AIR-COOLED TRANSFORMERS EXCLUSIVELY
1 to 2,000 KVA up to 15,000 Volts to meet Individual Requirements

- DISTRIBUTION
- GENERAL PURPOSE
- UNIT SUBSTATION
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
- MOTOR STARTING

Write for Bulletin #49-ACO

NEMA

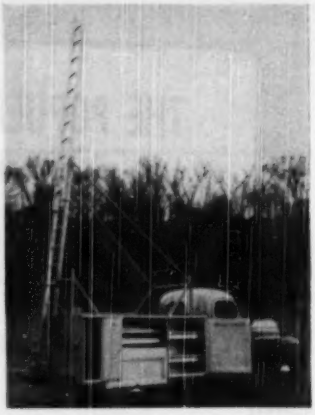
MARCUS TRANSFORMERS CONFORM TO THE STANDARDS OF N.E.M.A. AND A.I.E.E.

Representatives in Principal Cities

MTC

MARCUS TRANSFORMER CO. INC.
32 MONTGOMERY STREET
HILLSIDE 5, NEW JERSEY

PIONEERS IN THE FIELD OF AIR-COOLED TRANSFORMERS



rial bins and hooks. A sliding steel top covers the center section. Two vertically hinged doors are at rear. Units are available for ½, ¾, and 1-ton rated trucks.

Delphi Body Works, Delphi, Ind.

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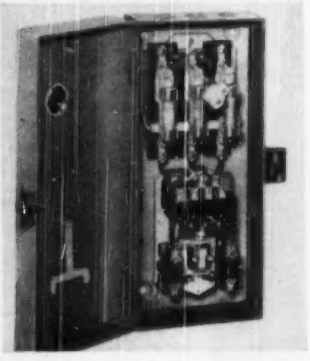


Magnetic Starters

AC COMBINATION magnetic starters with disconnect switches, Bulletin 4120 type, are available in fusible and non-fusible models. Starters feature: Front operation, thermal overload protection,

MORE NEW EQUIPMENT

Just Received

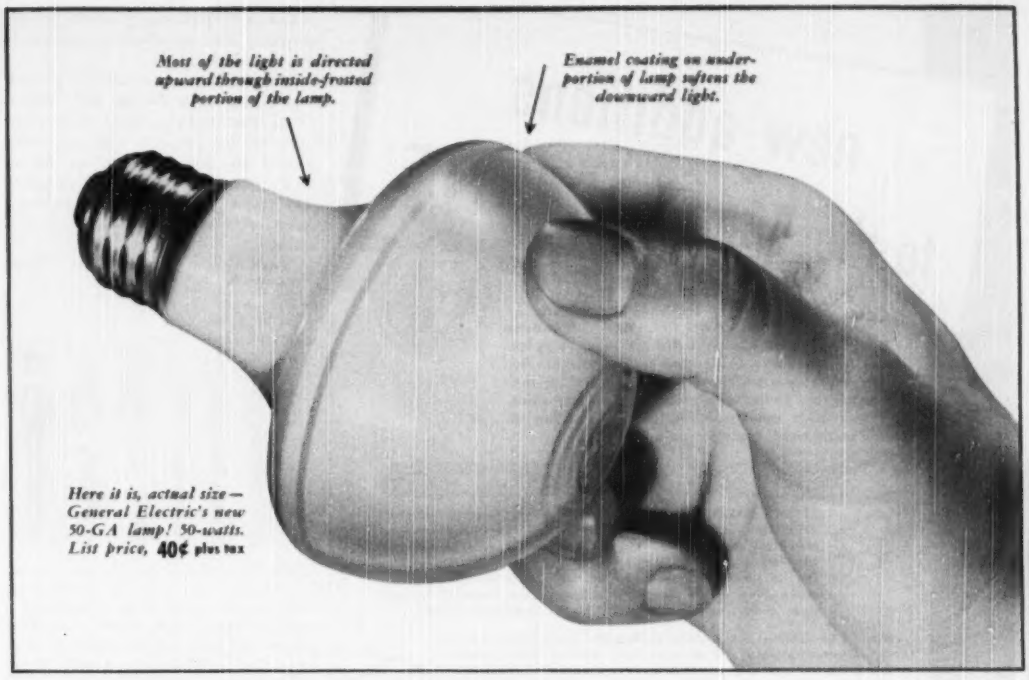
Appearing Next Issue

DEADEND TOOL
For changing defective insulators on double insulator strings

PHASE SEQUENCE INDICATOR
Portable sequence indicator built for circuits from 60 to 600 v

POWER FUSE
Current-limiting fuse has 100,000-amp interrupting capacity

HEAVY-CURRENT TRANSFORMER
Low-voltage transformers to 500 kva for heating applications


Most of the light is directed upward through inside-frosted portion of the lamp.
Enamel coating on under-portion of lamp softens the downward light.
Here it is, actual size—General Electric's new 50-GA lamp! 50-watts. List price, 40¢ plus tax

A market of 100,000,000 sockets for this new kind of lamp!

New General Electric 50-GA lamp is specially designed for fixtures like these . . .

HERE'S a new General Electric lamp bulb to meet the needs of the hundreds of customers in your neighborhood who have ceiling fixtures like those shown here. It's the new 50-GA lamp—specifically designed for overhead lighting fixtures where bare lamps in base-up position are now used. This new lamp bulb adds beauty to chandeliers and fixtures, gives a charming, indirect-lighting effect, softens the light to flatter home furnishings and complexions.

The secret lies in a revolutionary new shape that directs most of the light upward, plus an enamel coating on the lower part of the lamp which gives the downward light added glamour and warmth.

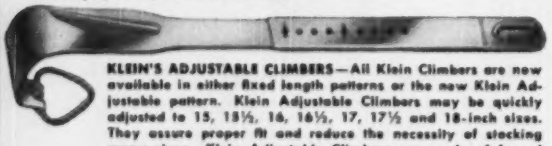
Surveys indicate that American homes have more than 100,000,000 sockets that need 50-GA lamp bulbs. And the new appeal of the 50-GA lamp will mean greater use of ceiling fixtures and fewer empty sockets than before. Now available in 50-watt size at 40¢, plus tax.

GENERAL ELECTRIC

new additions to the KLEIN LINE

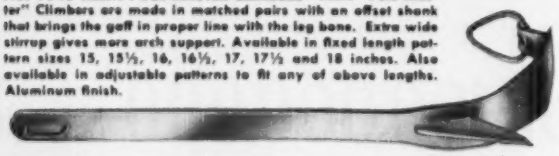
Since 1857

Mathias Klein & Sons continues to offer the electrical industry the most complete line of pliers and equipment on the market. Below are three additions to the Klein Line that have found favor with many utility companies. If you have not had complete information on this equipment, write for details.



KLEIN'S ADJUSTABLE CLIMBERS—All Klein Climbers are now available in either fixed length patterns or the new Klein Adjustable pattern. Klein Adjustable Climbers may be quickly adjusted to 15, 15½, 16, 16½, 17, 17½ and 18-inch sizes. They assure proper fit and reduce the necessity of stocking many sizes. Klein Adjustable Climbers are made of forged steel, individually tempered and tested. Aluminum finish.

No. 1945 KLEIN POLE MASTER CLIMBERS—Klein "Pole Master" Climbers are made in matched pairs with an offset shank that brings the gaff in proper line with the leg bone. Extra wide stirrup gives more arch support. Available in fixed length pattern sizes 15, 15½, 16, 16½, 17, 17½ and 18 inches. Also available in adjustable patterns to fit any of above lengths. Aluminum finish.



No. 9249 "KLEIN-LINE" TOOL BELT—This new belt is designed with a full-floating sliding trace of famous "Klein-Kord." Trace slides through alloy steel guides, allowing approximately 6 in. free movement. Chafing is avoided, and undue wear on safety strap is prevented. Apron design permits visual inspection of trace throughout its entire length.

A soft, pliable latigo leather cushion 4½ inches wide is pad-lined and edge rolled for comfort. The 2-inch wide belt shape is of heavy harness leather with a drop forged buckle. Made in following sizes: 36, 38, 40, 42, 44 and 46 inches.

Ask Your Supplier
Foreign Distributors:
International Standard Electric Corp., New York

The New Klein Catalog giving full information on the complete Klein line will be sent on request.

Mathias KLEIN & Sons
Established 1857 Chicago, Ill., U.S.A.
3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

provision for padlocking in "on" or "off" position, and interlock protection in "on" position.

The starters are available in four standard sizes to 50 hp, 3-ph, 550 v, 60 c. Standard operating coils can be supplied for 110, 220, 440, and 550-v service on frequencies of 25, 50, or 60 c. Standard starters are equipped with manually reset overloads, although automatic reset may be had on special order.

Ward Leonard Electric Co., Mount Vernon, N. Y.

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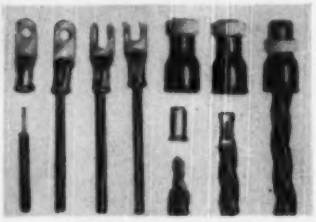

TERMINAL LUGS—The Termend solderless lug can reportedly be installed on wire sizes from No. 16 to 8 Awg with a single crimping tool, enabling stocking economies. They are available in ring, spade, and locking spade tongue styles.

Buchanan Electrical Products Corp, 1290 Central Ave, Hillside, N. J.

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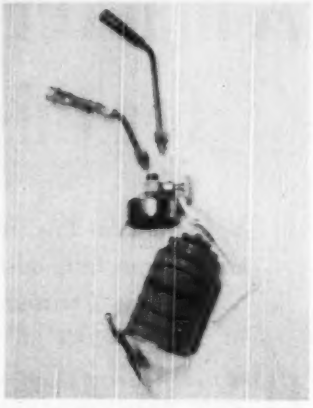
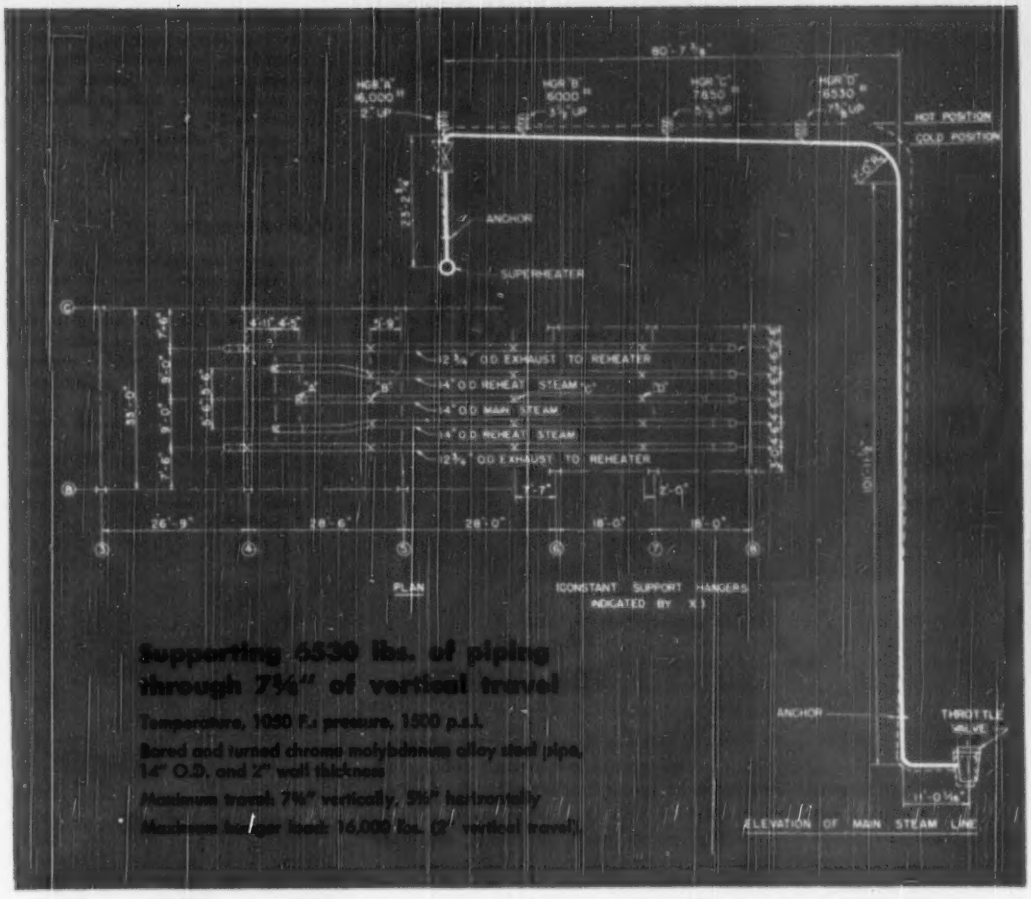


Hand Torch

INSTANT LIGHTING with a match, without pouring, pumping or priming, is claimed for the Prepo hand torch. It burns with a clean blue flame at more than 2,200 F.

Uses include sweating lugs on heavy cable, soldering, heating metal for bending or re-shaping, and many industrial and home applications. Two interchangeable burning tips are available: The larger tip throws a broad flame to supply considerable heat quickly; the other tip has a long pin-


HGR "A"
HGR "B"
HGR "C"
HGR "D"
HOT POSITION
COLD POSITION
ANCHOR
SUPERHEATER
12¾" OD EXHAUST TO REHEATER
14" OD REHEAT STEAM
14" OD MAIN STEAM
14" OD REHEAT STEAM
12¾" OD EXHAUST TO REHEATER
PLAN
CONSTANT SUPPORT HANGERS INDICATED BY X
Supporting 6530 lbs. of piping through 7⅛" of vertical travel
Temperature, 1050 F., pressure, 1500 p.s.i.
Bored and turned chrome molybdenum alloy steel pipe, 14" O.D. and 2" wall thickness
Maximum travel, 7⅛" vertically, 5⅛" horizontally
Maximum hanger load: 16,000 lbs. (2" vertical travel).
ANCHOR
THROTTLE VALVE
ELEVATION OF MAIN STEAM LINE

ONLY a Grinnell Constant-Support Hanger solves this problem easily, practically

Provides constant support to piping subject to vertical movement — in all hot and cold positions. Maintains full safety factor in supporting high temperature, high pressure piping. Non-resonant and energy absorbing. Mass-produced from standard precision parts. Individually calibrated for each installation. Load-adjustment features incorporated into design. Models to meet entire range of load-travel specifications. Minimum headroom required.

Believing that a good piping job is too important to be jeopardized by improvised or inadequate pipe hangers, Grinnell has developed a complete line of stock hangers and supports for every piping need from a simple water pipe to a high pressure, high temperature steam line. Write for Catalog 10-D.

GRINNELL

Grinnell Company, Inc., Providence, R. I. Branches: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

"Automatic" AER-O-FOAM FOR INDUSTRY

Considered to be one of the foremost recent advancements in the science of fire protection, "Automatic" AER-O-FOAM has opened new avenues in fire safety which heretofore were not thought to be practical or economically feasible. Hazardous conditions familiar to chemical processing industries, metal working plants, petroleum storage and handling, electric power generation, and other occupancies where flammable liquids are involved, can now be fully safeguarded by engineered "Automatic" AER-O-FOAM protection.

A hydrolyzed protein, manufactured from a soya bean base, AER-O-FOAM, when mixed with water and aerated, forms a smothering tenacious blanket capable of flowing around obstacles. The system is set into operation "Automatically" through the quick response of highly sensitive Rate-of-temperature-Rise heat detectors and allows for the speedy extinguishment of fires involving gasoline, benzol, naphtha, and many other flammable liquids.

This form of protection also provides important engineering advantages evidenced in the improvement of drainage conditions, reduction of water supply requirements, non-corrosive action of the foam material and prevention of re-flash. As "Automatic" AER-O-FOAM dehydrates rapidly following application, clean-up operations are practically non-existent.

Better investigate the advantages of "Automatic" AER-O-FOAM protection for those stubborn fire areas in your plant. More detailed information is available through your nearest "Automatic" Sprinkler representative. He'll be happy to furnish you with surveys and estimates without cost or obligation. Write or call today.

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN 1, OHIO

"Automatic" Sprinkler
FIRST IN FIRE PROTECTION
DEVELOPMENT . ENGINEERING MANUFACTURE . INSTALLATION
OFFICES IN PRINCIPAL CITIES OF NORTH AND SOUTH AMERICA

point flame for soldering.

The fuel, compounded of petroleum hydrocarbons, is self-pressurizing and self-vaporizing. Empty fuel containers may be replaced in 30 sec. Weight of the torch in 1½ lb.

Pressure Products Corp, 140 N. Dearborn St, Chicago 2, Ill.

•

Volt-Ammeter

THE SPLIT-CORE transformer of Model A-5-1 volt-ammeter is said to handle conductors up to 1⅛ in. diam. This model is the third to be added to the line of pocket size volt-ammeters designed for maintenance men, engineers, electricians, and motor repair and service shops.

Jaws are opened by a plastic finger trigger. It has seven ranges: 6.5/13/26/65/130 amp and 150/600 v. Accuracy is stated as ±3% of full scale.

Pyramid Instrument Co, 49 Howard St, New York 13, N. Y.

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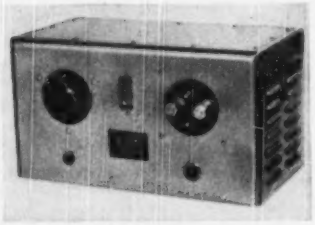


High Current Test Unit

MOTOR overload conditions are simulated with the Multi-Amp high current test unit by supplying overload currents to the tripping element of the overload relay only. Testing is performed with the associated motor de-energized.

In addition to overload relay testing, the manufacturer reports that it can be used for circuit breaker testing and calibrating, drying out damp motors or electrical windings, soldering or brazing, annealing and hardening metals, and thawing frozen water pipes.

Up to 500 amp, adjustable in stepless increments, can be supplied. Operation in from a 110-v, 60-c outlet, with 10 amp required for 500 amp at output.

Custom Electric Controller Co, 119 Cross St, Harrison, N. J.

•

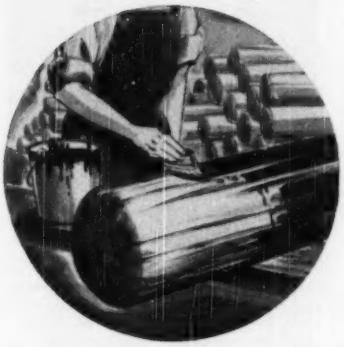
Heat Resistant Wire

NICKEL-CLAD copper wires are said to provide the electrical conductivity of copper combined with the heat and corrosion resistant properties of nickel. Diameters ranging from 0.010 to 0.005 in. are well suited for stranding and

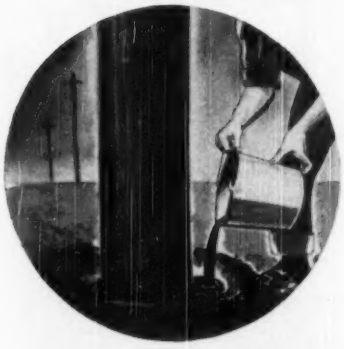
make relocated poles last longer with

MONSANTO PENTAchlorophenol

(SANTOPHEN 20)



BRUSH ON PENTA after pole has been removed and cleaned.



POUR ON PENTA after pole has been reset.

Here's how one utility uses penta to add years to the life of poles they set, pull and reset:

When a pole is removed and cleaned, a 5% solution of Monsanto Penta dissolved in proper oil is brushed on. The pole then is stored until it's needed in another spot.

In resetting the pole, the fill is tamped to within a few inches of the top. Two gallons of the penta solution then are poured around the wood. A bar is forced down along the pole to bring the preservative in closer contact with the butt end of the pole. The fill then is completed and a collar of sand or loose dirt is made at the ground line. A half gallon of penta solution is poured onto the collar and covered lightly.

Penta, applied in this way, is practical, effective, economical. Ordinary care in handling is necessary to protect workmen, animals, trees and crops.

If you would like more details about this use of Monsanto Penta, or if you want other information on wood preservation, mail the coupon or contact the nearest Monsanto Sales Office.

MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1758-E South Second Street, St. Louis 4, Missouri.

Santophen Reg. U. S. Pat. Off.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

MONSANTO
CHEMICALS — PLASTICS

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
1758-E South Second Street, St. Louis 4, Missouri

Please send further details on the use of penta to preserve relocated poles. Send data on the use of penta for.....

Name..... *Title*.....

Company.....

Street.....

City..... *Zone*..... *State*.....

SERVING INDUSTRY . . . WHICH SERVES MANKIND

MOSINEE PAPER MILLS CO.
MOSINEE, WISCONSIN

MOSINEE

"More than Paper"

In the field of electronics and the electrical goods industry, MOSINEE stands for paper-base processing materials with scientifically controlled chemical and physical properties, high quality standards and dependable uniformity... with good dielectric strength, high tensile or tear strength; proper softness or stiffness; creped with controlled stretch or flexibility; specified pH for maximum-minimum acidity or alkalinity; accurate caliper, density, liquid repellency or absorbency . . . or other technical characteristics vital to your quality standards and production requirements.

MOSINEE PAPER MILLS COMPANY • MOSINEE, WIS.

"Essential Paper Manufacturers"

for lead wire applications at high temperatures, the company reports. Applications of Kulgrid are where product fabrication or end use is in high temperature or corrosive atmospheres, such as leads for electric furnaces, home appliances, and a wide range of laboratory and industrial equipment.

Sylvania Electric Products, Inc, 60 Boston St, Salem, Mass.

•

FORGED MANHOLE STEPS — Three sizes of forged aluminum manhole steps and ladder rungs are adaptable to concrete, brick or concrete block wall. High corrosion resistance and non-sparking characteristics of aluminum are said to be particularly advantageous.

Aluminum Co of America, 801 Gulf Bldg, Pittsburgh 19, Pa.

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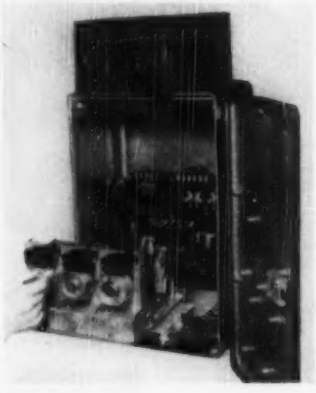


Traffic Controller

A NEW TYPE traffic controller has been designed for application in the field of pre-timed traffic control, whether interconnected or not.

Each individual dial unit of the controller is operated by a Telechron synchronous motor. Timing settings are said to be tamperproof, the housing being dust and water resistant. Entire

YOU CAN BE SURE.. IF IT'S

Westinghouse

A New 100-AMPERE Type GR Recloser...

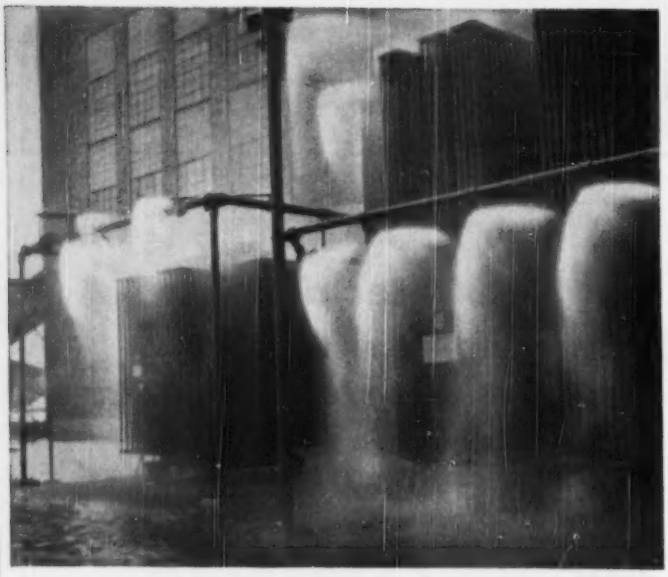
For Rural and Suburban Distribution

- 100 amperes—continuous current rating
- 2,000-2,500 amperes—interrupting rating
- Full 15-kv insulation (110-kv impulse withstand)
- Interrupts 2,000 amperes with full 15 kv across one pole
- Heavy top casting and deep-drawn tank—both heavily hot-dip galvanized
- *One* fast, and *three* time-delay openings, or *four* time-delay openings
- Bushings, mechanism, hangers—all interchangeable with 50-ampere series
- Five coil sizes available—25, 35, 50, 70, 100

The 100-ampere GR Recloser is available for immediate delivery now. Use it to provide complete, economical protection for your rural *and suburban* lines. For complete information, ask your Westinghouse representative or distributor for Bulletin B-4339, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60721

WESTINGHOUSE

GR RECLOSERS



BLAW-KNOX KNOCKS TRANSFORMER FIRES

WITH FAST-ACTION FOG SYSTEM

Deluge Systems, Wet Pipe Systems, Dry Pipe Systems, Water Spray and Fog Systems, Rate-of-Rise Sprinkler Systems, and Carbon Dioxide Extinguisher Systems.

The instant fire breaks out in any transformer—indoors or out—the Blaw-Knox rate-of-rise thermostat sounds the alarm and starts a dense, quenching fog of water to the danger spot. Instant application of fog extinguishes the fire and protects adjacent transformers and equipment. The remainder of the bank is back in service in short order. Blaw-Knox Fog Nozzles have no screens to clog, do not require treated water and maintain their effective spray pattern even at reduced pressures.

At your request a Blaw-Knox Engineer will come to your office for consultation. He will make a survey of your fire hazards, secure your insurance underwriter's requirements, prepare a preliminary layout of a system that will give you the utmost in fire protection, and submit an estimate of costs—all without obligation.

BLAW-KNOX SPRINKLER DIVISION
OF BLAW-KNOX CONSTRUCTION COMPANY
829 Beaver Ave., N.S., Pittsburgh 12, Pa.
Offices in Principal Cities

BLAW-KNOX FIRE PROTECTION SYSTEMS

assembly can be removed by disconnecting an electrical plug and loosening two mechanical disconnects. "Flash" operation is possible with the timer removed.

General Electric Co, Lighting & Rectifier Div, Schenectady 5, N. Y.

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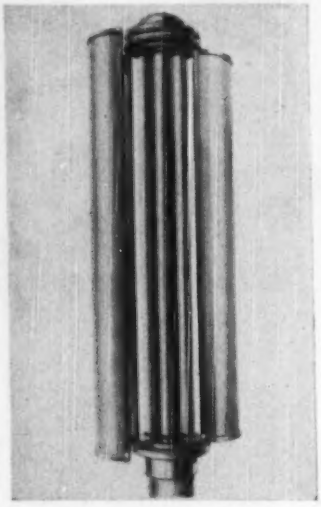


Island Light

Six 40-w T-12 instant start, high humidity lamps are included with a fluorescent island light which measures 59 in. high and 9⅝ in. diam. Photo illustrates the fixture with hinged glass frames in open position for relamping and maintenance.

The fixture is completely wired, with a weathertight housing sealed by sponge rubber and putty. Structural framework is of 14 gage steel channel. Fire-frosted ribbed glass is housed in extruded aluminum frames. An easily operated leveling device is said to permit adjustment on post or standard.

Guardian Light Co, 301 W. Lake St, Oak Park, Ill.

•

MORE NEW PRODUCTS
about which you should know

Square D Co, 6060 Rivard St, Detroit 11, Mich., is offering a 2-pole "Ad-On" **multibreaker** to extend circuit arrangements on Type MO 8 load centers for lighting loads. Type MO 2A is a thermal-magnetic common trip breaker for adding a water heater, clothes drier, or other 220-v load . . . General Electric Co, Schenectady 5, N. Y., has a Trigger-Start **ballast** for instant starting of residential fluores-

You can do a lot

with a little

GOLD SEAL TAPE

There's no waste! It *goes further* . . . gives you more tape value in every roll.

Gold Seal is easier to handle, too. Tears evenly, quickly — will not dry out, peel, or ravel.

Production of Gold Seal Tape is laboratory-controlled to assure lasting "tack" in the friction compound. With every fiber of its top quality base cloth thoroughly impregnated, you can count on it to make a tighter, longer-lasting bond.

Ask your supplier for Gold Seal Tape. See if it doesn't save time on the job, and help make better-taped joints. In single rolls and handy 10-roll containers. Each roll cellophane-wrapped to reach you *factory fresh*. Jenkins Bros. (Rubber Div.), 100 Park Ave., New York 17, N. Y.

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet both ASTM and Federal Specifications.

JENKINS Gold Seal Tape

FRICTION and RUBBER TAPES

MADE BY JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES

they'll tell you that... although most tapes look alike, there is a big difference — in quality and in workability. Men who work with tape know from experience that Accurate Tapes have the proper tackiness for fast, easy application, that it wraps tight and stays tight, will not ravel and tears off clean.

As for performance qualities, Accurate Tapes have high dielectric and tensile strength, superior aging qualities and are backed by 30 years of specialized experience in tape manufacture. It's important to note, too, that every foot of Accurate Specification Tape exceeds ASTM standards by a wide margin. Specify Accurate on your next tape order — it's the sure way to guarantee quality.

WAREHOUSE STOCKS and representatives strategically located for prompt, efficient service from coast to coast. Write for name of representative nearest you and illustrated catalog — just address ACCURATE MANUFACTURING COMPANY, GARFIELD, NEW JERSEY.

ACCURATE ASTM FRICTION TAPE exceeds all requirements of ASTM designation: D69-48T.

ACCURATE ASTM RUBBER TAPE exceeds all requirements of ASTM designation: D119-48T.

ACCURATE TAPE

cent lighting; no starters are required.

STERLING ELECTRIC MOTORS, INC, LOS ANGELES 22, CALIF., has in production a line of gear-head electric **motors**, the Slo-Speed, which can be mounted in any position, including vertically with shaft pointing down. . . . ALLIED CONTROL CO, INC, 2 EAST END AVE, NEW YORK, N. Y., has a new sensitive **relay**, Model SW, in either an open or hermetically sealed model, ac or dc.

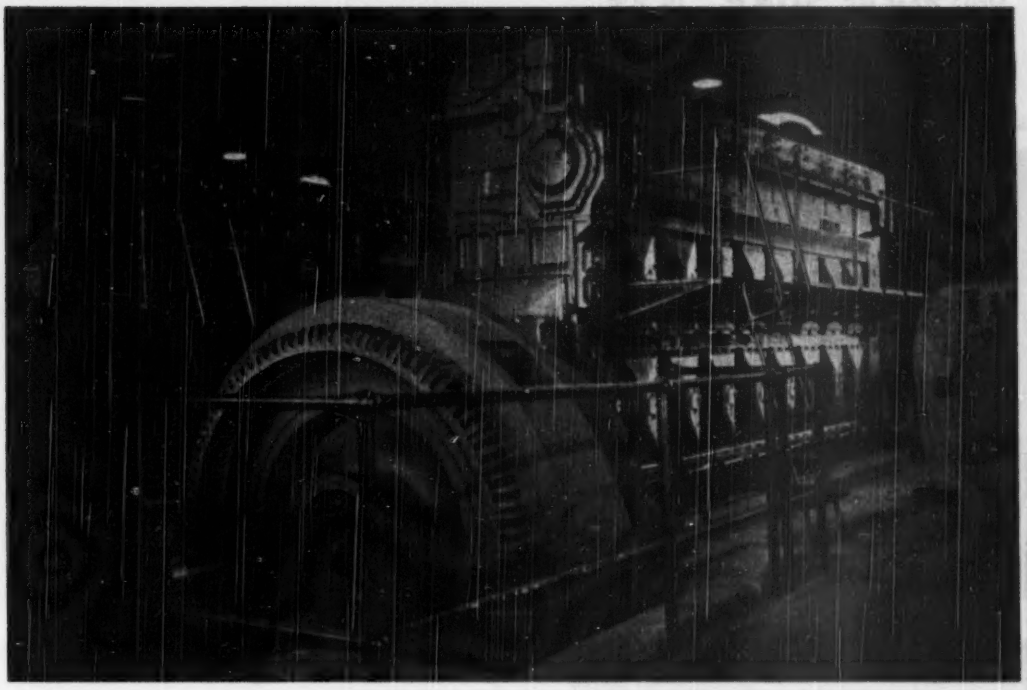
UNIVERSITY LOUDSPEAKERS, INC, 80 S. KENSICO AVE, WHITE PLAINS, N. Y., is making explosion-proof **speakers** for use in hazardous locations. . . . MID-STATES GUMMED PAPER CO, 2515 S. DAMEN AVE, CHICAGO 8, ILL., anticipates that its **Tape-Strap** will be approved as a substitute for metal strapping for many types of containers. It has a tensile strength of 180 lb per in of width; sizes from ½ in. to 4 in.

ECONOMY FUSE AND MFG CO, 2717 GREENVIEW AVE, CHICAGO 14, ILL., has developed the Transpro **protector** as a secondary-operated primary opening for use with gas tubes in high-voltage circuits—as for protection of sign circuits. . . . THE LEVEL CO, INC., 113-117 KANSAS AVE, KANSAS CITY, KAN., has a **ladder leveler** for extending ladder legs up to 16 in.

W. L. MAXSON CORP., UNIMAX SWITCH DIV, 460 W. 34TH ST, NEW YORK 1, N. Y., is offering the MXM safety **interlock**, said to allow circuits to be manually reclosed for testing, without danger of being "found" hot later; details on data sheet 501A. . . . Unimax also has Type MX-1-Z25 **switch** which gives a differential motion in the range 0.0005-0.008 in. for critical pressure and thermostatic controls and timing devices.

WESTINGHOUSE ELECTRIC CORP, P. O. Box 2099, PITTSBURGH 30, PA., has announced Type AM pneumatic time delay **relay**, with adjustable delay from 0.2 to 200 sec for industrial timing functions. . . . THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA 42, PA., has designed Type L portable **strain indicator** for 120-ohm gages with factors of 1.77 to 2.20; provision is made for oscilloscope connections.

COFFING HOIST CO, DANVILLE, ILL., is producing a safety **drop hook** of 6,000 lb capacity, which weighs 2¼ lb; a 40-lb pull will release the 3-ton load. When released, jaws remain in the open position for easy reloading. . . . EUTECTIC WELDING ALLOYS CORP, 40 WORTH ST, NEW YORK 13, N. Y., is marketing Eutectrode 2101 welding **electrode** for aluminum and aluminum alloys; tensile strength is 34,000 psi.



SUPERIOR'S ECONOMY PAYS BIG DIVIDENDS

Three Superior Diesels have raised operating plant efficiency 36% for a power company in Virginia.

This installation houses three generating units powered by Superior Diesel Engines. Each engine develops 1440 bhp at 360 rpm. Records kept over a period of three years show that Superior Engines are generating 13.66 kwh per gallon of fuel compared with 10 kwh per gallon of fuel for other engines installed in this plant. And Superior's low fuel consumption keeps operating costs to a minimum.

It's economies like these that have built confidence and have produced excellent operating records for Superior users.

A Superior representative will be glad to explain all the economies you get with Superior. Just write and tell us when he should call. Meanwhile, send for our fully illustrated booklet *Superior Diesels For Stationary Applications.*

THE NATIONAL SUPPLY COMPANY
SUPERIOR ENGINE DIVISION
Plant and General Sales Office: Springfield, Ohio

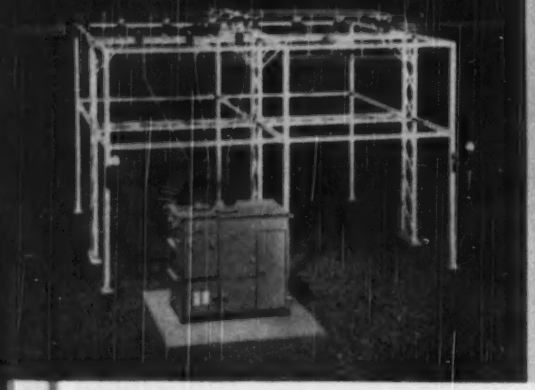
THE NATIONAL NSCO SUPPLY COMPANY

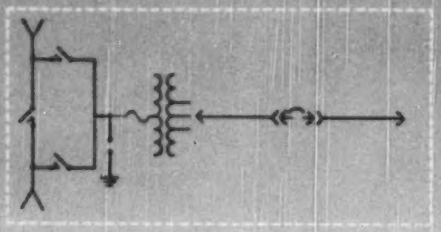
Superior DIESELS

Locomotive · Marine · Oil Field · Stationary

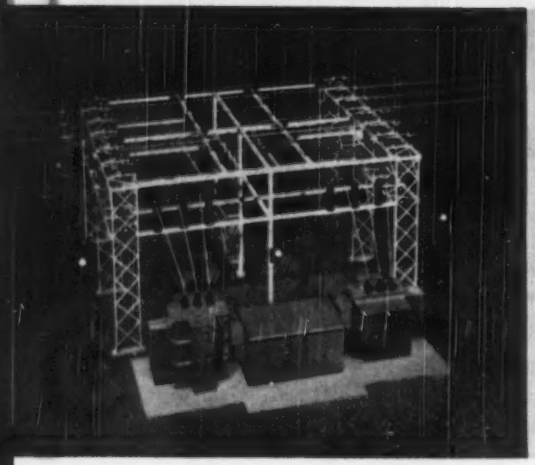
YOU CAN BE **SURE**.. IF IT'S

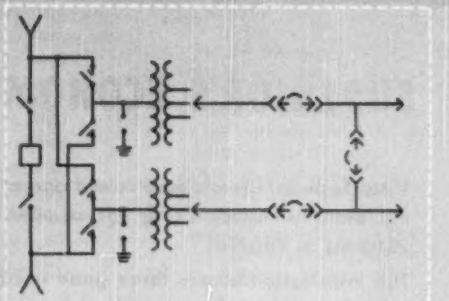
Westinghouse



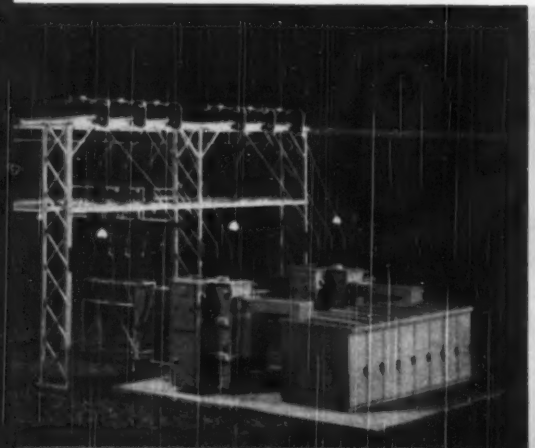


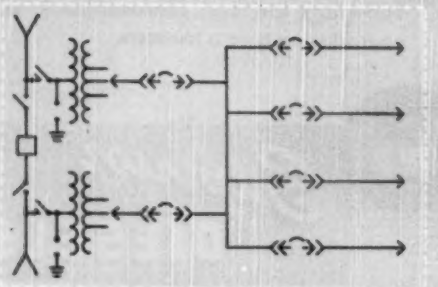
Single-feeder CSP Substation—Loop or tie subtransmission circuit—Manual sectionalization, manual selection.





Two-feeder Duplex Substation—Loop or tie subtransmission circuit—Automatic sectionalization, manual selection.

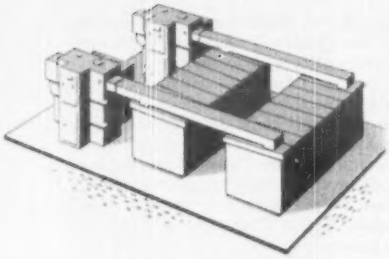




Three-or-more-feeder Spot Network Substation—Loop or tie subtransmission circuit—Automatic sectionalization.

SUBSTATIONS with A FUTURE

...lower power distribution costs



The system planning you do today must allow for future load growth, and load shifts . . . if lower power distribution costs are to be realized. The substations you choose *now* will help make this possible . . . *if they are designed with a future!*

The Westinghouse Coordinated Substations, shown here, have this "allowance for the future". They not only meet today's load demands, but provide the flexibility vital for future changes in load requirements. *They Become One of Your First Steps in Lowering Power Distribution Costs.* Their design is a result of today's modern power distribution trends. These trends are reducing distribution costs by simplifying systems and standardizing equipment. Simplifying subtransmission circuits reduces the amount of equipment used. Standardizing equipment results in production savings that are passed on to you.

Due to the compactness of these Substations, "blocks of power" can be easily and economically added or removed to take care of increased load requirements, load shifts or relocations. You realize maximum salvage value.

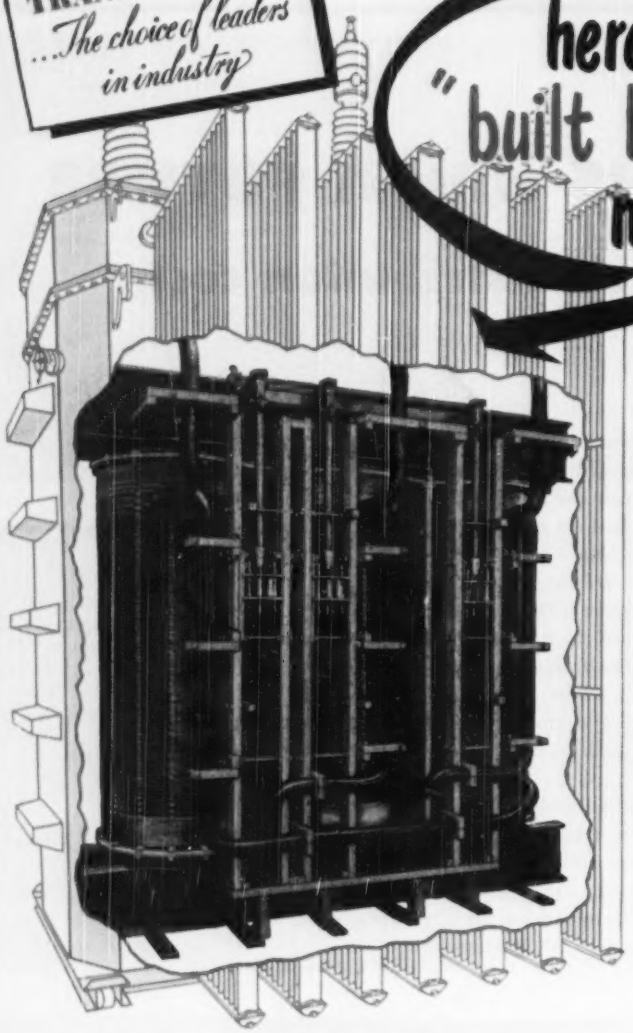
For more complete information, get your copy of the Coordinated Substation Book, B-4061. Ask your Westinghouse representative for it, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60728-A

Westinghouse

COORDINATED SUBSTATIONS

WAGNER TRANSFORMERS
...The choice of leaders in industry

here's what "built by Wagner" means



Wagner Power Transformers have a reputation for Quality—established through sixty years of service to the power industry. Constant improvements in materials and shop practices—meticulous attention to even the smallest details of construction—rigid maintenance of quality controls—have made Wagner Power Transformers "the choice of leaders in industry." Wagner Transformers give years of uninterrupted service because of features like these:

The coils, wound with cable paper insulated conductor, are carefully insulated from each other, and are surrounded by liberal oil ducts. Coils adjacent to the line ends have extra turn insulation and additional coil-to-coil insulation to absorb the impact of high voltage line disturbances. Coil stack assemblies have locked-in insulating spacers placed radially around the coils to maintain the oil ducts. The coil stacks are vacuum-dried, then securely fastened between heavy steel end clamps and the endplate assembly, bracing the structure to withstand short circuit conditions. All outgoing leads are heavily insulated to prevent any possibility of breakdown. All leads are mechanically held in place to maintain proper electrical clearance at all times and under all conditions of operation. Snap-acting tap changers are gang operated from outside the transformer tank by means of a shaft brought out through the tank wall.

The complete story of Wagner Power Transformer construction is told in Bulletin TU-181. Write for your copy.

Wagner maintains thirty-one branch offices, located in principal cities, for quick, convenient engineering service and consultation. Consult the nearest branch for competent advice on your next transformer installation.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

NEWS ABOUT PEOPLE

Pepco Appoints Bisset Chief Operating Engineer

George Bisset has been appointed chief operating engineer of Potomac Electric Power Co. He will be in charge of all operating departments, including generating, distribution, substation, meter, motor transportation, and building operations and the bureau of police.

GEORGE BISSET

Archie V. Hawkins has been made director of purchasing and stores, and Miss Helen M. Martell was elected an assistant secretary.

Bisset has been general superintendent of Pepco's electric system since 1945. He joined the company in 1919 as a helper in the meter department. Three years later he was transferred to the substation department and placed in charge of relay and automatic equipment. He served as assistant superintendent of the latter department from 1932 to 1940, when he was made assistant to the chief engineer. He was named operating assistant to the general manager in 1941.

Before joining Pepco Bisset worked for the aeronautical instrument section of the U. S. Bureau of Standards. He is a member of the board of governors of the Engineers Club of Washington, past president of the Kilowatt Club, and a member of AIEE, the Washington Board of Trade, and the Washington Building Congress.

Hawkins has been Pepco's purchasing agent for 27 years. He started as a messenger in 1902, when he was 14 years old. In 1947-48 he was president of the Washington District of the National Association of Purchasing Agents. He is a member of the Public Utility Buyers Group of the national association.

•

Feldmann to Head Sales for Worthington Pump

Walther H. Feldmann, president of Electric Machinery Manufacturing Co, Minneapolis, has been named vice president in charge of sales for Worthington Pump & Machinery Corp, Electric Machinery's parent. He will be succeeded by Richard H. Olsen, now Electric Machinery vice president in charge of sales.

In other Worthington changes, John J. Summersby will become vice president in charge of purchases, Frederic W. Thomas general manager of purchases, and Carleton Reynell general representative, sales and purchasing departments.

Feldmann joined Electric Machinery in 1922 after having served as a power sales engineer with Consolidated Gas, Electric Light & Power Co of Baltimore. He served successively as district manager, general sales manager, vice president, and general manager until his election as president in 1944.

Olson has been with the subsidiary since 1919. After starting at the Minneapolis district office he was transferred to St. Louis in 1925 as district manager and in 1930 became district manager at New York. He was named vice president in charge of sales in 1944.

•

Winsor Martin, secretary of Pioneer Service & Engineering Co, will succeed **Edward N. Strait** as manager of the rate and research section. Strait, who organized the section in 1916 for a predecessor company of Pioneer, is retiring. He also has been with the Railroad Commission of Wisconsin and has headed the rate committees of Edison Electric Institute and American Gas Association. Also retiring are **Herbert S. Whiton,** consulting mechanical engineer, and **Carl A. Bessey,** electrical engineer. Whiton went to a Pioneer predecessor in 1923 from Minneapolis General Electric Co. Bessey has been with the Pioneer companies for 40 years.

Gruhl Elected President of Wisconsin Association

Alfred Gruhl, assistant vice president of Wisconsin Electric Power Co, has been elected president of Wisconsin Utilities Association, trade organization for electric, gas, and local transportation companies. He succeeds Carl A. Altenbern, Burlington.

ALFRED GRUHL

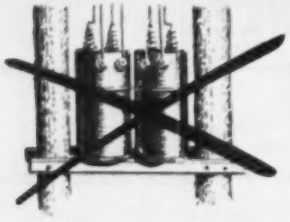
E. H. Cotton, vice president in charge of operations in Wisconsin for Northern States Power Co, will succeed Gruhl as vice president of the organization. Irwin P. Steybe, assistant secretary and assistant treasurer of Wisconsin Public Service Corp, was named treasurer, succeeding Paul J. Imse, Milwaukee Gas Light Co.

The new president entered the utility industry in 1932 as junior engineer with Milwaukee Electric Railway & Light Co, predecessor of Wisconsin Electric Power. Later he served as research engineer.

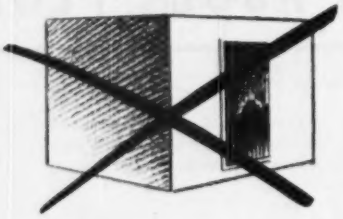
•

Ray Martin has been appointed director of advertising and **Dennis S. Melvin** manager of the advertising department of Consolidated Edison Co of New York. Martin has been assistant director of advertising since 1948. He joined Consolidated Gas Co as a salesman in 1922 and later served Con Ed as art director, assistant manager, and manager of the advertising department. He pioneered in the dramatic presentation of uses of appliances in utility advertising, and displays prepared under his direction have won more than 100 national

NO OUTDOOR PLATFORMS



NO EXPENSIVE VAULTS



when you install a HEVI DUTY DRY TYPE TRANSFORMER

Smart utility engineers reduced installation costs by placing this Hevi Duty 225 KVA 4160-240 Volt type 31FH transformer in unused storage space of a customer's office building.

Save on Installation and Maintenance Costs!

Hevi Duty Dry Type Transformers are available in a wide range of sizes and types from ¼ to 1000 KVA with primary ratings to 15000 Volts.

Conservative design, vacuum pressure impregnation, and precise testing assure long and economical service. Write for bulletin HD 499.

HEVI DUTY ELECTRIC COMPANY

HEAT TREATING FURNACES **HEVI-DUTY** ELECTRIC EXCLUSIVELY

DRY TYPE TRANSFORMERS — CONSTANT CURRENT REGULATORS

MILWAUKEE 1, WISCONSIN

awards. Melvin, who will concentrate on administrative and organizational matters, has been manager of the construction contracts bureau in the purchasing and stores department. He joined the system in 1929 as a district salesman for United Electric Light & Power Co.

•

Sylvania Electric Names Balcom Board Chairman

Max F. Balcom has been elected chairman of the board of Sylvania Electric Products, Inc, to succeed the late Walter E. Poor. Frank A. Poor, founder of the company, was elected vice chairman.

Balcom has been with Sylvania since 1918 when he became purchasing agent for a predecessor company, Novelty Incandescent Lamp Co, in Emporium, Pa. In 1931, with the formation of Hygrade Sylvania Corp, he was made assistant secretary of the new organization and placed in charge of radio costs and general corporate work. He became a director in 1934. Three years later he was elected vice president in charge of the radio division and in 1944 treasurer.

•

K. A. Vaughan, manager of field engineering for Gould Storage Battery Corp, Trenton, N. J., since 1945, has been advanced to the newly created position of manager of sales engineering. He will supervise Gould's field engineers and service stations and coordinate matters pertaining to quotations, inquiries, and negotiations at Gould's sales headquarters. Vaughan has been with Gould since 1928.

C. C. Clymer has been appointed manager of the materials handling and testing equipment division of General Electric Co's Industrial Engineering Divisions. He succeeds **M. A. deFerranti,** who has been named assistant to the manager of the parts division of the Aircraft Gas Turbine Divisions.

•

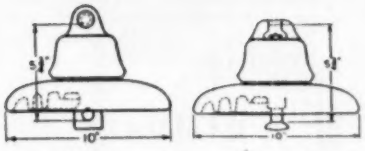
New Assignments

John C. Herbert has been appointed purchasing agent for Potomac Electric Power Co, Washington, D. C. He has been assistant purchasing agent since last October . . . New director of purchases of Iowa-Illinois Gas & Electric Co, Davenport, Iowa, is **Erwin F. Math,** who has been assistant purchasing agent of J. I. Case Co, Bettendorf, Iowa. He succeeds **Frank H. Hughes,** director of purchases for the Iowa firm and for United Light & Railways Service Co since 1947, who has accepted a

Left: Installing Victor suspension insulators on a power line in the Southwest

Install Victor Suspension Insulators

FOR DEPENDABLE ON-THE-JOB PERFORMANCE



No. 800 Clevis type

No. 900 Ball and socket type

VICTOR No.		800 and 900
60 cycle dry flashover	KV	80
60 cycle wet flashover	KV	50
Pos. impulse flashover	KV	125
Neg. impulse flashover	KV	130
Dry arcing distance	in.	7⅝
Leakage distance	in.	11½
Impact rating	in. lbs.	55
M and E strength	Lbs.	15000

CONTINUOUS, trouble-free insulator service *counts* when it comes to *lower* maintenance and replacement costs on transmission lines. That's why more and more successful power companies are *specifying* Victor suspension insulators.

Even under the most severe service conditions, you can rely on Victor's rugged suspension insulators for years of uninterrupted transmission. *Each* one is rigidly inspected and tested at *every* point of manufacture, and must *easily* meet *all* NEMA standards. For you this means dependable performance *on the job!*

Get All the Facts! **CALL YOUR VICTOR REPRESENTATIVE**

J. A. Perkins Co., *Boston, Mass.* • **T. B. Dally,** *Jersey City, N. J.* • **L. Morris Landers Co.,** *Atlanta, Ga., Charlotte, N. C.* • **Continental Sales & Engineering Co.,** *Pittsburgh, Pa.* • **H. J. Schwarberg,** *Cincinnati, O.* • **David D. Schneider,** *Louisville, Ky.* • **Braisted & Bair,** *Detroit, Mich.* **Homer G. Hall,** *Princeton, Ind.* • **Gaide & Dunlap,** *Chicago, Ill.* • **E. B. Rosmer Co.,** *Minneapolis, Minn.* • **Fred R. Hearn,** *St. Louis (Affton), Mo.* • **Chas. L. Ward Co.,** *Kansas City, Mo.* • **Southwest Sales & Service Co.,** *Shreveport, La.* • **George E. Tarbox,** *Denver, Colo.* • **Myron Swendson,** *Boise, Ida.* • **Maydwell & Hartzell,** *San Francisco, Cal., Los Angeles, Cal., Portland, Ore., Seattle, Wash.*

Also distributed nationally by **Line Material Company**

VICTOR INSULATORS Inc.

VICTOR, NEW YORK

Look for this trade mark of enduring service

V

ALWAYS SPECIFY
TRANSFORMER BUSHINGS
by
Illinois

Illinois' thorough control of production methods insures porcelain bushings of high dielectric and great mechanical strength, with utmost accuracy in the control of dimensions. Internal stress is prevented through careful drying and firing at scientifically controlled temperature levels.

Bushings can be standard glaze or radio interference-proof glaze. Dry type bushings are produced for all voltages up to 34.5 kv. Gasket seats are smooth, and ground when required.

EXACT DIMENSIONS
COMPLETE UNIFORMITY
HIGH DIELECTRIC STRENGTH
HIGH MECHANICAL STRENGTH

ILLINOIS
ELECTRIC PORCELAIN CO.
MACOMB, ILLINOIS

similar position with American Natural Gas Service Corp, Detroit . . . **Dr George H. Zirker** has been appointed chief metallurgist of Burndy Engineering Co, Inc, New York, manufacturers of electrical connectors. He formerly held a similar job with Foundry Service, Inc. . . . **Paul M. Deal** has been appointed administrative assistant in General Electric Co's Fractional Horsepower Motor Divisions . . . Four Wheel Drive Auto Co has appointed **Lloyd Pernot** manager of national accounts and **John Thompson** to be Pernot's successor as director of the service division. Thompson has been specialized markets manager . . . **Walter H. Garrett, Jr,** has been appointed district lamp engineer by Westinghouse Lamp Division's eastern district. He formerly was a lighting engineer for the Greenwich district of Connecticut Light & Power Co . . . **William W. Stifler, Jr,** of Engineering Research Associates, Arlington, Va., has joined the application engineering staff of Sprague Electric Co, North Adams, Mass.

•

Clarence L. Law has retired as vice president in charge of public relations for Consolidated Edison Co of New York after more than 43 years of service. Law joined New York Edison Co in 1906 and served it as general commercial manager and executive assistant to the president. When Con Ed's public relations activities were coordinated in 1939 he was named vice president. More recently he has also been a director of Westchester Lighting Co and Yonkers Electric Light & Power Co, Con Ed subsidiaries.

•

OBITUARY

Edwin S. Webster

Edwin Sibley Webster, 82, co-founder and retired chairman of Stone & Webster, Inc, Boston, died at his home in Chestnut Hill, Mass., May 10 after a short illness.

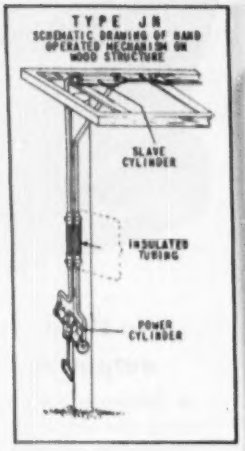
With the late Charles A. Stone he founded the engineering firm in 1889. At first the concern confined itself to electrical engineering, especially in the utility field. Later its activities were extended to general design, engineering and construction, supervisory services for utilities and industrial companies, investment banking, and finance.

Construction and engineering work alone has aggregated more than $2 billion since the company's formation. Projects carried on in the two World Wars included shipbuilding, synthetic rubber plants, and the electromagnetic plant for production of atomic bomb materials at Oak Ridge, Tenn.

Webster was president of Stone &

A ROYAL DEVELOPMENT
that revolutionizes switch operation

Motor-operated equipment, complete with three-pole switch and all elements needed for hydraulic operation—type JHM power unit, slave cylinder, and connecting tubing.



HYDRAULIC POWER opens and closes high voltage switches on substations and pole tops

In successfully applying smooth, positive hydraulic power to the operation of group-operated air break or disconnect switches, another first is added to Royal Engineers' achievements. Both hand-operated and motor-operated units are available and either can be varied or modified to meet any installation problem.

Hand-operated mechanism, type JM, with master cylinder, slave cylinder, and connecting tubing. New or existing switches can be converted to hydraulic operation with this equipment. Type JM is furnished with either reciprocating or horizontal operating handle.

Elaborate layout drawings are not required—
Installation is made on existing equipment with little expense—
Convenient and economical for installation on crowded substations—
When adding bays to a substation, mechanical layouts are unnecessary—
There are no outboard bearings, pipe supports, guides, etc.—
The fluid conducting lines are easily formed to clear obstructions—
Abuse of switch is eliminated by smooth, uniform travel of hydraulic power—
Standard stock items of hydraulic power transmission used wherever possible—
Power units, either manual or motor-operated, can be installed at some distance from substation. Fluid link can be run underground—

Fully descriptive bulletin sent upon request.

36 YEARS
A Part of the Arsenal of
AMERICAN POWER PRODUCTION

Royal ELECTRIC MANUFACTURING COMPANY
INCORPORATED
1122 EAST 87th STREET *Chicago 19, Ill.*
Designers and Manufacturers of Power Switching Equipment and Special Electrical Devices

To slash typing costs, increase typing output, meet your *every typing need!*

- Cost-conscious companies throughout the country are discovering new economies through use of Remington Electri-conomy Typewriter—the new electric typewriter that performs all typing requirements with greater ease—greater speed—greater accuracy.

- In test after test where the Remington Rand Electri-conomy Typewriter has replaced ordinary machines, the *increased typing output* is piling up extra profits—10% . . . 20% . . . 50% and even higher are the savings percentages reported by delighted users.

Send the coupon today for the amazing ECONOMY story of the Remington Electri-conomy Typewriter.

Copyright 1950 by Remington Rand Inc.

MAKE THE *Electri-conomy* TEST IN YOUR OFFICE TODAY!

SAVES WORK Electri-conomy SAVES MONEY

Remington Rand, Room 1201, 315 Fourth Ave., New York 10, New York

☐ Please send me FREE copy of "Electric Typing vs. Manual Typing."

☐ Please have your representative call to make the FREE Electri-conomy Test in my office—without obligation, of course.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Remington Rand THE FIRST NAME IN TYPEWRITERS

Webster for many years. He became vice chairman of the board in 1930 and

EDWIN S. WEBSTER

chairman in 1941 when Stone died. He retired in 1946 but continued as a director and consultant.

Webster had been a director of North Texas Electrical Co, Pensacola Electric Co, Puget Sound Traction, Light & Power Co, Savannah Electric Co, and other utility, investment, and manufacturing firms. He was a member of the American Institute of Electrical Engineers, the Boston Society of Civil Engineers, and the executive committee of the Corporation of Massachusetts Institute of Technology.

•

Basil Manley

Basil Manley, 65, former chairman of the Federal Power Commission and a nationally known economist, died in Washington May 11.

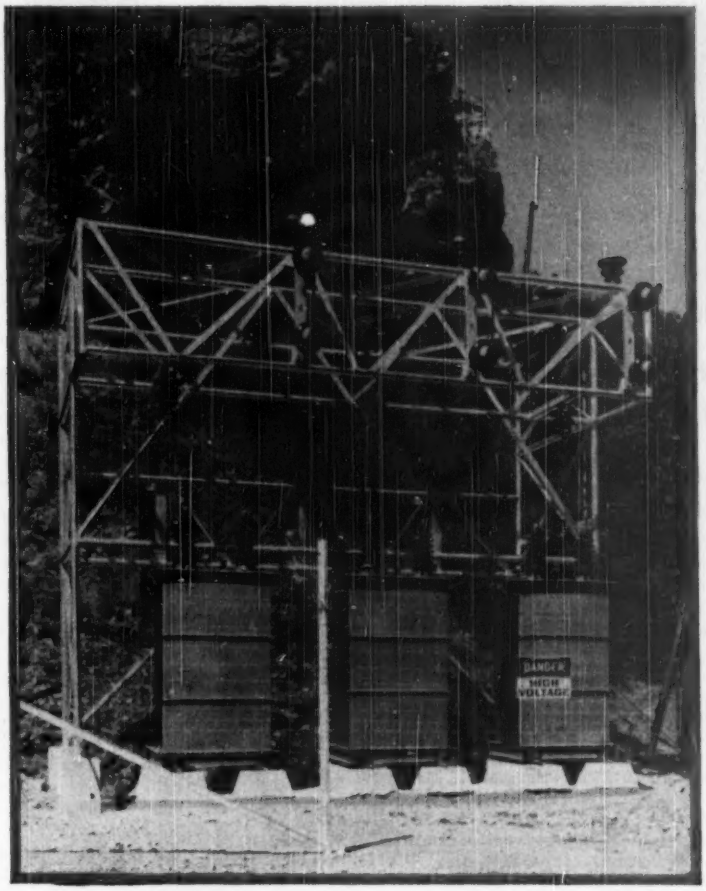
Manley retired as commission chairman in 1945 to become vice president and director of Southern Natural Gas Co. He was appointed to the commission by the late Pres Franklin D. Roosevelt in 1933, was vice chairman twice, and served as chairman in 1944-45.

Manley went to Washington in 1908 as an economist for the United States Bureau of Labor Statistics. Later he was director of the United States Commission on Industrial Relations, organized an economic service for the Scripps newspapers and Newspaper Enterprise Association, served the Federal Trade Commission as a consulting economist in the investigation of the meat packing industry, and was joint chairman of the National War Labor Board in World War I.

In 1931 Manley declined an appointment as chairman of the Wisconsin Utilities Commission to become Washington representative of the New York State Power Authority. He helped obtain an agreement between the state and federal

Springtime in the Rockies

with LARKIN TRANSFORMERS



● **600 KVA, three phase bank, 44,000 volts to 2400 volts, LARKIN TRANSFORMERS**

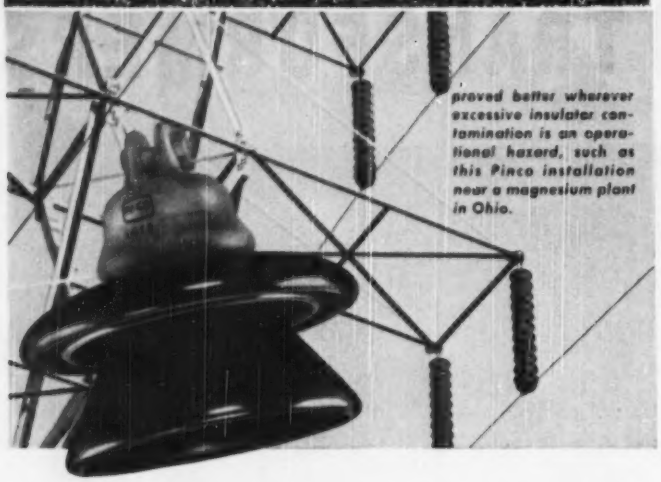
MANUFACTURED BY

LARKIN LECTRO PRODUCTS CORPORATION

PINE BLUFF • ARKANSAS

Sales Offices in Principal Cities

RIGHT for the JOB... RIGHT ON THE JOB!



proved better wherever excessive insulator contamination is an operational hazard, such as this Pinco installation near a magnesium plant in Ohio.

Competitive Tests...Service Records Prove the Superiority of PINCO L1612 "Universal" Insulators

In competitive "fog operation" tests conducted by a Western power company, Pinco L1612 Insulators rated . . .

FIRST on "fog arc over."

FIRST on sustained voltage "in fog" . . . NO arc over.

FIRST on sustained voltage "in direct spray" . . . NO arc over.

FIRST on both self-cleaning and manual cleaning characteristics.

SECOND on "sluice arc over."

EXCELLENT on radio interference characteristics.

We're proud that Pinco Insulators were so conclusively proved "right" by such laboratory tests. But we're even more proud to know that in actual operation under "fog" conditions, thousands of Pinco L1612's have been meeting their job requirements 100% on installations *made eighteen years ago!* Such a record of trouble-free service proves that they're "right" where it counts . . . "right on the job!" So when you have a tough job for insulators calling for L1612 characteristics . . . put up Pinco *to be sure!*

See Page 70, Pinco Catalog No. 49 for complete electrical and mechanical characteristics.

The Porcelain Insulator Corporation

761 Main Street, Lima, N. Y.

Sales Agents: JOSLYN MFG. & SUPPLY CO.
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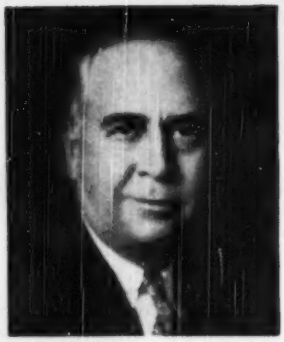
PINCO INSULATORS

Suspension Insulators . . . Switch and Bus Insulators . . . Distribution Clamps . . . Distribution Pin Types and Guy Strains . . . Transmission Line Fittings . . . Tree Insulators . . . Transformer and Circuit Breaker Bushings . . . One Piece and Multi-part High Voltage Pin Types . . . Suspension and Strain Clamps . . . Indoor Bus Support Porcelain . . . Lightning Arrester Porcelain.

• 1920 Thirty Years Service to the Electrical Industry 1950 •



BASIL MANLEY

authorities on development of St. Lawrence River water power.

One of Manley's most notable achievements with FPC was the initiation, planning, and supervision of the National Power Survey, first comprehensive appraisal of the nation's power resources. He also planned and supervised the Electric Rate Survey, the first nationwide compilation and analysis of electric rates, and started compilation of the first official national maps of electric utility service areas, generating plants, and transmission lines.

As vice chairman of the National Defense Power Committee just before World War II Manley helped work out agreements for increases of generating capacity in critical areas and headed a committee that adopted standards for steam-electric generating station equipment. On FPC his attitude was one of cooperation with the industry. He insisted on a fair rate of return, saw no excuse for regulation unless it was constructive, and urged that public power agencies be subject to the same regulatory requirements as private utilities.

Manley also had contributed articles on current economic topics to a number of daily newspapers and was the author of *Coordination and Integration of Electric Utilities* and *Defense Power Requirements.*

•

Walter Roy Elliott, 68, a former project manager for Salt River Valley Water Users Association, Phoenix, Ariz., died May 4 in Phoenix after a long illness. He also had worked for the Bureau of Reclamation and the Federal Works Project Association.

Glenn H. Bell, 49, Upper Columbia district manager of Bonneville Power Administration since 1940, died recently in Spokane. Before joining BPA Bell worked for Los Angeles' power and light department, Service Electric Co, Hynes, Calif., and for Inland Empire Rural Electric, Inc, Spokane, as superintendent and project manager.

FIGHT → WOOD'S NATURAL ENEMIES

WITH U·S·S CREOSOTE OIL

● For more than 100 years, the wood preserving industry has found creosote oil the surest protection against wood's natural enemies. It is highly toxic to termites, borers, fungi and dry rot. And its oily nature helps to minimize the checking and cracking due to temperature changes.

With proper creosote oil treatment, you can greatly reduce natural failure of poles and crossarms . . . hold future replacement costs to a minimum.

To obtain maximum protection, use or specify U·S·S Creosote Oil. Continuous processing in the world's largest tar distillation plant assures you *consistently high* quality . . . consistently good results. For complete information, contact the nearest sales office listed below.

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Brown-Marx Building, Birmingham 2, Ala. 25 Beale St., San Francisco 5, Calif.

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CREOSOTE OIL

UNITED STATES STEEL

was this call necessary?

Some "Moral Insurance" here might have avoided a serious accident

Workmen's compensation is a fine thing—but it can't replace a mangled arm.

Safety laws prevent many accidents—but they can't cover every hazard of an individual plant.

Accident prevention which goes *beyond the law* is an unwritten responsibility of every employer. It is his "Moral Insurance" for his employees welfare.

The premiums for "Moral Insurance" are not high. They do not have to be paid for in fancy safety gadgets. Their cost is simply the institution of common sense safety regulations covering all local hazards—enforced by employee committees with the full support of management.

Yes—"plant safety" is a mutual job.

DON'T FORGET—THE LIFE YOU SAVE MAY BE YOUR OWN

A PUBLIC SERVICE PROJECT ★ THE ADVERTISING COUNCIL ★

Published in the public interest by:

McGRAW-HILL PUBLICATIONS

Lionel has satisfied itself that through Quinterra, they have a step-down transformer that is virtually harm-proof for their customers of all ages.

The LIONEL CORPORATION

FACTORIES AND SERVICE DEPT. SAGER PLACE IRVINGTON 11, N. J.

Johns-Manville, Inc.
270 Madison Ave.
New York, N. Y.
Att: Mr. B. B. Woodford

September 29, 1949

We believe that you will be interested to learn of our experience with "Quinterra" insulating sheet.

The Lionel Corporation has been using "Quinterra" as insulation between the primary and secondary windings of our toy transformers almost from the first day that this material was commercially available.

Due to its superior mechanical strength, its high insulating properties, and especially its resistance to charring even under burn-out tests, short circuits and leakage between the two windings have been entirely eliminated. The user of the transformer can now be assured of perfect safety from 110-volt shock even though through some mishap he has burned out the transformer.

It should be a source of gratification to the developers of this material to know that they have made an important contribution to the safety of electrical devices both large and small.

Yours very truly

THE LIONEL CORPORATION

Joseph L. Bonanno
Chief Engineer

Jlb:nr
enc.

"Railroad" discovers *Quinterra* insulation adds new safety factor for customers

REPORT AFTER REPORT from users of Quinterra shows that this revolutionary, new Johns-Manville purified asbestos high-temperature electrical insulation is effecting major improvements in transformer design.

And more than that. These reports show that manufacturers are not only obtaining important sales advantages for their electrical products through the use of Quinterra . . . but they are also saving time and money in their manufacturing operations, as well!

This paper-thin, continuous sheet insulation is being widely used in transformers and coils. Its lasting dielectric strength, due to its resistance to pyrolysis, assures a greater safety factor and longer operating life. Quinterra withstands substantially higher temperatures than the hot-spot limit of 130C for Class B insulations.

QUINTERRA

- ✓ **cuts factory rejects**
- ✓ **reduces complaints**
- ✓ **improves production rate**
- ✓ **produces more uniform product**
- ✓ **cuts costs of operations**

Johns-Manville
ELECTRICAL INSULATIONS

Johns-Manville
Box 290, New York 16, N. Y.

Kindly send me a copy of
Johns-Manville Quinterra Electrical Insulation EL-34A.

Name _____

Company _____ Position _____

Address _____

City _____ State _____ EW-5

ELECTRICAL INSULATION IS OUR SPECIALTY

Q. *What ONE wire and cable producer grows its own natural rubber, and makes its own synthetic rubber?*

A. UNITED STATES RUBBER COMPANY.

Q. *What ONE wire and cable producer makes plastics?*

A. "U. S."

Q. *What is the most important part of wire and cable?*

A. The insulation.

Q. *Who is best equipped to make wire and cable with superior insulation?*

A. U. S. RUBBER—which grows its own natural rubber, makes its own synthetic rubber, manufactures its own plastics.

Working with a valuable and rare electron-microscope in the laboratories of the United States Rubber Company. This microscope magnifies 100,000 times. The technician is examining compounding ingredients, one of the many steps taken to insure the finest insulation possible.

Isn't it logical that a rubber company should make the best wire and cable insulation there is? U. S. Rubber has been a pioneer in insulation for over 70 years—has amassed in that time a stockpile of research data and experience that can't be beat. Electrical insulation is a "U. S." specialty!

Electrical insulation makes the difference between superior and ordinary wire and cable. Conductors of all manufacturers are standard, but insulation must be the best that science can produce. That's why your best bet in wire and cable is U. S. Rubber.

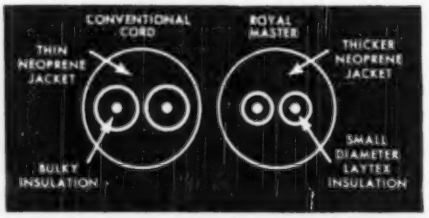
SOME MORE OF THE MANY DIFFERENT VARIETIES OF "U. S." WIRE AND CABLE

UTILITIES: Power Cables • Street Lighting • Royal Cords • Network Cables • Utility Control • Pole & Bracket Cable • Service Entrance • Weatherproof • Zip Cord Pole Fixture Cable • Sup. Control

RAILROADS: Power Cables • Communications • Railway Signal • Royal Cords • Welding Cable • Railway Utility • Sup. Control • Weatherproof

HEAVY INDUSTRY: Power Cable • Royal Cords • Welding Cables • Control Cables • Machine Tool Wire • Building Wire • Switchboard Wire • Thermostat Cable • Bus Drop Cable

ONLY
U. S. ROYAL MASTER PORTABLE CORDS
PROVIDE
DOUBLE PROTECTION
WHERE NEEDED MOST



For trouble-free, long-life service under very severe conditions, the small diameter of Laytex insulation permits a neoprene jacket of almost double the thickness of the jacket on ordinary heavy-duty cords—thus providing double protection where it's needed most. Rayon braids cover the Laytex insulation for added protection at terminals and for color-coding. Made only by U. S. Rubber, Royal Master Cords are the world's best heavy-duty portable cords.

Available in sizes 18 to 10 AWG, in 2, 3 and 4-conductor assemblies. Known as Type SUO by the National Electrical Code and Underwriters' Laboratories.

U.S.RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY
ELECTRICAL WIRE & CABLE DEPT. • ROCKEFELLER CENTER, NEW YORK 20, N.Y.

GEOGRAPHICAL DISTRIBUTION OF ETL CLIENTS

Taken from Orders Entered During the 1948-1949 Period

City	Orders
ALABAMA	
Birmingham	1
ARIZONA	
Phoenix	1
ARKANSAS	
Blytheville	1
Little Rock	3
Paragold	1
CALIFORNIA	
Berkeley	1
Carmel	1
Emeryville	1
Hawthorne	1
Hollywood	1
Inglewood	37
Los Angeles	43
Oakland	3
Sacramento	1
San Francisco	6
San Pedro	1
Santa Ana	1
South Gate	1
COLORADO	
Boulder	2
Denver	4
Golden	1
CONNECTICUT	
Branford	2
Bridgeport	91
East Chester	1
Essex	2
Fairfield	2
Glastonbury	5
Greenwich	2
Hartford	37
Ivoryton	1
Jewitt City	1
Meriden	49
Middletown	2
Mystic	5
New Britain	2
New Haven	33
New London	4
Norwalk	19
Old Greenwich	3
Plainfield	1
Saugatuck	1
Springdale	17
Stamford	12
Waterbury	5
Watertown	4
Weatherfield	1
Westport	3
Willimantic	1
Windsor Locks	1
Winsted	1
DELAWARE	
Ft. Miles	2
Lewis	2
Newport	7
Wilmington	37
DIST. OF COL.	
Washington	202
FLORIDA	
Keystone Hgts.	1
Miami Beach	2
Miami	2
Orlando	10
Tampa	28
GEORGIA	
Atlanta	5
Hampton	1
IDAHO	
Twin Falls	4
ILLINOIS	
Alton	4
Aurora	1
Bellwood	2
Chicago	182
Chicago Hgts.	2
Danville	1
Effingham	4
Elgin	2
Geneva	2
Joliet	4
Kankakee	1
Moline	3
Schiller Park	1
INDIANA	
Alexandria	1
Anderson	91
Connersville	2
Dunkirk	2
Evansville	1
Ft. Wayne	5
Indianapolis	1
Kokomo	1
Lafayette	1
La Porte	1
Logansport	1
Marion	8
Mishawaka	1
Newport	1
Richmond	5
Union City	1
IOWA	
Ft. Madison	2
Newton	1
KANSAS	
Wichita	1
Ottawa	2
KENTUCKY	
Bellevue	1
Louisville	10
Prestonburg	2
LOUISIANA	
New Orleans	4
Jackson	7
Greenville	1
Hazel Park	2
Kalamazoo	4
Midland	3
Mt. Clemens	2
Middleville	2
Parchment	1
Royal Oak	1
Saginaw	7
Sault Ste. Marie	4
St. Joseph	1
Wyandotte	1
MINNESOTA	
Duluth	3
Internat'l Falls	3
Minneapolis	6
MISSISSIPPI	
Jackson	1
MISSOURI	
Carthage	8
Kansas City	52
No. Kansas City	5
St. Joseph	3
St. Louis	110
MONTANA	
Opheim	1
Sydney	1
NEBRASKA	
Lexington	4
Omaha	2
Tekanoh	1
NEW HAMPSHIRE	
Concord	14
Exeter	23
Manchester	1
New Market	1
NEW JERSEY	
Arlington	11
Atlantic City	1
Bayonne	4
Belleville	16
Bendix	5
Berkeley Hgts.	2
Kearny	9
Berlin	1
Beverly	3
Bloomfield	110
Boonton	5
Bound Brook	10
Camden	5
Carlstadt	2
Carteret	5
Clifton	35
Closter	1
Dunnellen	2
Earle	6
East Orange	2
East Paterson	4
East Rutherford	1
Edgewater	4
Elizabeth	38
Englewood	4
Fanwood	2
Ft. Hancock	2
Ft. Monmouth	10
Garwood	2
Haldon	1
Hillside	1
Hoboken	76
Irvington	8
Jersey City	22
Kenilworth	4
Lincoln Park	1
Linden	19
Little Falls	1
Loch Arbor	1
Madison	1
Manville	3
Maplewood	6
Margate City	1
Medford	14
Metuchen	5
Milltown	6
Murray Hill	13
Newark	176
New Brunswick	3
Newton	3
North Arlington	1
North Bergen	34
No. Hackensack	1
Orange	6
Parlin	4
Passaic	57
Paterson	15
Perth Amboy	6
Plainfield	1
Pompton Lakes	4
Pompton Plains	6
Red Bank	3
Ridgefield	1
Riegelsville	3
Roselle	1
Rutherford	2
Sayerville	1
Somerville	1
Summit	1
Teterboro	2
Trenton	28
Union City	8
Verona	1
Washington	18
Westfield	2
West Orange	5
Westwood	5
NEW MEXICO	
Monterey	2
NEW YORK	
Albany	1
Ausable Forks	1
Bear Mountain	1
Beaver Falls	1
Binghamton	19
Boonville	1
Brookhaven	1
Buffalo	24
Canajoharie	2
Canastota	2
Central Islip	1
Chauncey	1
Corinth	10
Corning	4
Cuba	1
Dexter	2
Dobbs Ferry	1
Dunkirk	3
Elmira	12
Endicott	5
Freeport	1
Ft. Edward	1
Fulton	1
Glen Cove	1
Glens Falls	17
Groton	1
Hast'gs-on-Hud.	25
Holesite	9
Irv.-on-Hudson	1
Jamestown	2
Lake Success	1
Larchmont	1
Lindenhurst	1
Little Neck	4
Lockport	1
Merrick	2
Middletown	17
Mineola	22
Minetto	1
Monroe	16
Montour Falls	27
Mt. Vernon	16
Newburgh	6
New Rochelle	4
N. Y. City	1772
Niagara Falls	2
Oswego	1
Palmyra	1
Patchogue	14
Pearl River	2
Peekskill	22
Plattsburg	1
Pleasantville	10
Poughkeepsie	5
Rochester	38
Rock City Falls	1
Rockville Centre	3
Rome	7
Roslyn Hgts	31
Saranac Lake	6
Schenectady	4
Seneca Falls	1
Silver Creek	1
Suffern	7
Syracuse	10
Utica	2
Watertown	1
White Plains	2
Yonkers	12
NO. CAROLINA	
Ashville	3
Gastonia	1
Goldsboro	12
Lumberton	1
Monroe	1
New Bern	2
Raleigh	6
Sanford	1
Wadesboro	4
Wilmington	9
Winston-Salem	1
OHIO	
Akron	2
Alliance	1
Archbold	1
Canton	61
Carroll	6
Cincinnati	120
Cleveland	129
Columbus	7
Dayton	13
Findlay	1
Hamilton	13
Lancaster	1
Mansfield	4
Marietta	3
Munroe Falls	2
Newark	14
North Canton	3
Sebring	6
Tiffin	2
Toledo	25
Toronto	4
Troy	1
Vermilion	19
Warren	5
West Lafayette	13
OKLAHOMA	
Oklahoma City	1
OREGON	
Portland	4
PENNSYLVANIA	
Allentown	10
Ambler	1
Ardmore	3
Bethlehem	3
Breckinridge	7
Bridesburg	17
Canonsburg	1
Carlisle	5
Chester	9
Chester Springs	1
Clark Summit	12
Coatsville	2
Conshohocken	1
Downington	1
East Pittsburgh	3
East Stroudsburg	5
Elkland	1
Erie	28
Essington	1
Girard	1
Glenside	3
Gouldsboro	3
Harrisburg	6
Hatboro	2
Homer City	1
Jeannette	1
Jenkintown	49
Lancaster	7
Lansdale	10
Lansdowne	1
Marietta	1
Miquon	1
Monaca	7
Monaco	8
New Cumberland	5
Oil City	4
Perkasie	18
Philadelphia	339
Phoenixville	1
Pittsburgh	116
Port Allegany	2
Pottstown	2
Ramsey	1
Reading	1
Roaring Springs	2
Sayre	4
Scranton	2
Warren	3
Washington	1
Waynesboro	2
Wilkes-Barre	3
Wissahickon	1
York	2
Youngwood	1
RHODE ISLAND	
Bristol	3
Cranston	1
Pawtucket	5
Phillipdale	1
Providence	16
Westerly	1
SOUTH CAROLINA	
Charleston	2
Greenville	1
Laurens	1
Spartenburg	1
TENNESSEE	
Bristol	1
Chattanooga	5
Johnson City	3
Kingsport	7
Knoxville	1
Memphis	1
Nashville	1
TEXAS	
Austin	1
Dallas	3
El Paso	1
San Angelo	1
Texas City	1
Houston	2
Nacogdoches	7
VERMONT	
Montpelier	60
St. Albans	2
VIRGINIA	
Charlottesville	1
Fredericksburg	2
Harrisonburg	1
Lynchburg	1
Norfolk	1
Radford	1
Richmond	17
Roanoke	17
WASHINGTON	
Seattle	5
Shelton	3
Spokane	10
WEST VIRGINIA	
Bluefield	1
Clarksburg	1
Dunbar	1
Huntington	12
Rainelle	1
Star City	1
WISCONSIN	
Kenosha	1
Milwaukee	27
Racine	4
Ripon	1
Two Rivers	1
Oshkosh	1
Wisconsin Rapids	2
OUTSIDE U.S.A.	
CANADA	
Edmundston	12
Montreal	6
Toronto	10
Windsor	1
ENGLAND	
London	2
PUERTO RICO	2
URUGUAY	
Montevideo	3
GRAND TOTAL	
Orders	**6,580**
States	**44**
Cities	**479**

ALL-OVER helps by ETL

to SAFEGUARD EFFECTIVENESS in DESIGN OPERATION MARKETING

1950 BULLETIN illustrates these helps to business

ELECTRICAL TESTING LABORATORIES, INC.

2 EAST END AVENUE at 79th STREET
NEW YORK 21, N. Y.

and plenty of it . . FOR IMMEDIATE DELIVERY

In anticipation of industry's future needs for electric power, the AG&E System is spending $340,000,000 over a five year period for new generating plants and facilities. *But we also have all the power industry needs right now . . . today.*

Fact is, we have men out constantly, calling on industries, homes and farms in person, selling them power "for immediate delivery."

Through printed advertising like this, we're telling our present customers that we have power for sale . . . more power than they're now using . . . extra power they could use to their own advantage.

There is no power shortage in the area we serve. Greater demand, yes. The demand's been greater every year since the war. But every year we've met the demand in full. We have power for sale aplenty.

American Gas and Electric Company

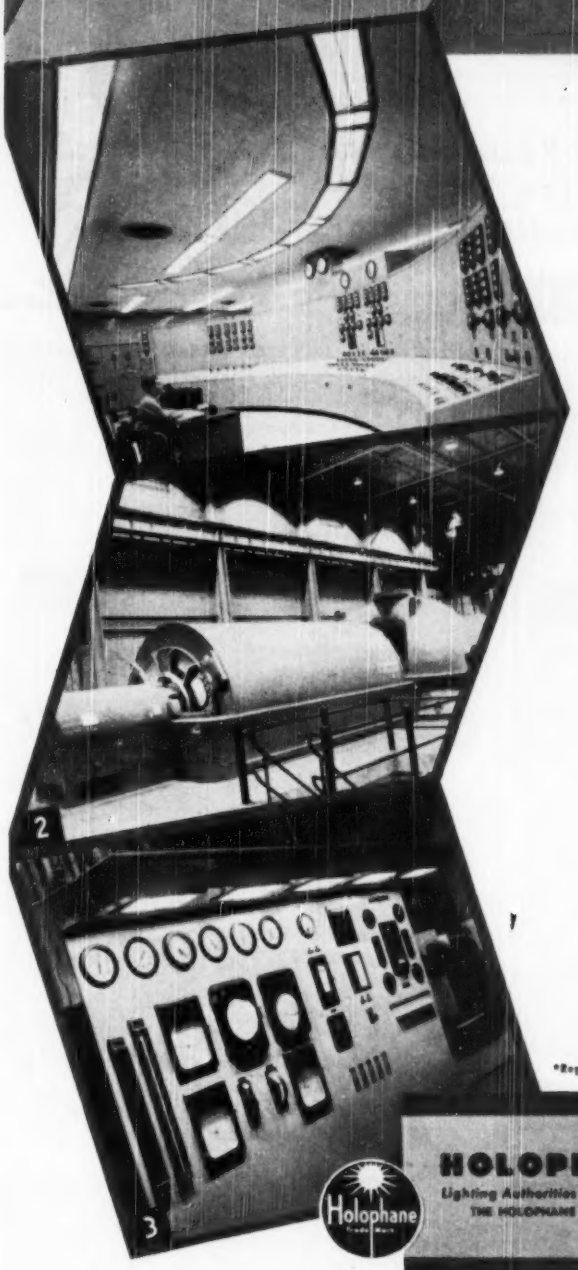
and its operating subsidiaries:

Appalachian Electric Power Company
Indiana & Michigan Electric Company
Kentucky and West Virginia Power Company, Inc.
Kingsport Utilities, Inc.
The Ohio Power Company
Wheeling Electric Company

HOLOPHANE . . . . *Lighting*

for GENERATING STATIONS . . .

through three decades



The recently completed Alexandria, Va. Generating Station of the Potomac Electric Power Co.—(STONE and WEBSTER, Engineers and Constructors), is an outstanding example of new Holophane Lighting Equipment for Generating Stations.

1 Control Room showing the use of In-Bilt HOLOFLUX* Fluorescent CONTROLENS*

2 Turbine Room effectively illuminated by Holophane HIBAY* units

3 Turbine Board with canopy housing Holophane incandescent CONTROLENS

Holophane Engineers have kept abreast of the trends in design and construction. New techniques are continually developed to meet all practical requirements for specialized lighting equipment. Holophane Engineering Service is offered, without charge or obligation, to consulting engineers for modernization, addition or new generating plant lighting including:

- Coal handling, conditioning and ash disposal
- Turbine rooms
- Boiler plants
- Boiler and turbine control boards
- Control rooms, electrical and mechanical
- Dispatch boards
- Switch yards and outdoor substations
- Gate house
- Outdoor lighting of plant property

Write for latest Holophane Engineering data on Generating Station Lighting

*Reg. U. S. Pat. Off.

Holophane

HOLOPHANE COMPANY, Inc.

Lighting Authorities Since 1898 • 342 MADISON AVENUE, NEW YORK 17, N.Y.

THE HOLOPHANE COMPANY, LTD., 346 QUEENSWAY, TORONTO 14, ONTARIO

Every One A WINNER

Make COLLYER Your Source for Overhead Service Cables— either standard or built-to-order.

NEUTRAL SUPPORTED CABLES

One, two, three or more phase conductors spiralled around the supporting neutral conductor.

1. **DOUBLE LAYER TYPE** — Phase wires have double-layer covering — Performance Grade Rubber Insulation protected by outer sheath of abrasion resistant Neoprene.
2. **SINGLE LAYER TYPE** — Phase wires have single layer covering of Insulating Neoprene.

TWISTED CABLES

Two, three or more conductors insulated with Performance Grade Rubber.

1. **RUBBER and BRAID TYPES** — (a) Conductors twisted together and covered with weather and flame resistant braid.

   (b) Conductors covered with moisture resistant braid. Twisted cable covered with moisture resistant braid.

   (c) Conductors covered with weather and flame resistant braid . . . then twisted together. One conductor often of double or triple weather proof wire to serve as the neutral.
2. **RUBBER and NEOPRENE TYPE** — Conductors sheathed with abrasion resistant Neoprene . . . then twisted together. One conductor often of Neoprene line wire to serve as the neutral.

CONCENTRIC NEUTRAL CABLES

One, two, three or more phase conductors insulated with Performance Grade Rubber, Sheathed with Neoprene, phase conductors assembled either parallel or twisted.

1. **NEOPRENE JACKETED TYPE** — Neutral conductor consisting of many small copper wires applied concentrically . . . then protected with a sheath of abrasion resistant Neoprene.
2. **EMBEDDED NEUTRAL TYPE** — Neutral conductor (many small copper wires applied concentrically) embedded in a covering of felted unspun cotton — weather-resistant finish.

OPEN WIRE SERVICES

Copper or aluminum conductors covered with Neoprene or Polyethylene.

NATIONAL ELECTRIC CODE STANDARDS

Type SD Service drop cables. Type SE, Style A, armored service entrance cable. Type SE, Style U, unarmored Service entrance cable.

Let us know your needs for any and all types of overhead service cables. Write for recommendations. COLLYER INSULATED WIRE COMPANY, 245 Roosevelt Ave., Pawtucket, Rhode Island.

CHOOSE *Collyer*

OVERHEAD SERVICE CABLES

Album of Achievement

If photographs of all the plants engineered, designed and constructed by EBASCO during the last half century were put in one album—more than *one billion* dollars of investment in new construction would be represented.

But engineering, design and construction tell only part of the story. For in addition to these projects—a few of which are shown here—EBASCO specialists have helped management solve problems in many other phases of business and industry—such as financing, business studies, insurance, systems and methods and industrial relations.

EBASCO's team of engineers, constructors and business consultants has the experience and the knowledge to help you expand or modernize your plant—and help you keep your business operating efficiently. Moreover, they can do the whole job, or any part of it—from preliminary planning to "in service" operation—and do it anywhere in the world.

Call on EBASCO for the help you need. You'll find its team of seasoned specialists will get your job done quickly and efficiently.

Write for the booklet *"The Inside Story of Outside Help"* describing the many EBASCO services available to you. Ebasco Services Incorporated, Dept. M Two Rector Street, New York 6, N.Y.

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Budget	Financial	Purchasing	Systems & Methods
Business Studies	Industrial Relations	Rates & Pricing	Taxes
Consulting Engineering	Inspection & Expediting	Research	Traffic

EBASCO SERVICES

INCORPORATED

NEW YORK · CHICAGO WASHINGTON, D.C.

Ebasco Teamwork gets things done anywhere in the world

(Advertisement)

More Business—More Profit—for Contractors

NOCRETE
WITHOUT CONCRETE ENCASEMENT

ORANGEBURG
Fibre Conduit News

STANDARD
WITH CONCRETE ENCASEMENT

VOL. 1 NO. 4 JUNE 1950

CONTRACTORS AGREE—THIS CONDUIT LAYS FASTEST AND AT LOWEST COST!

From the minute the first length is loaded on the truck till the final length is laid in the trench, ORANGEBURG CONDUIT saves time, work and money for the contractor. And once laid, this high quality conduit provides a safe, permanent underground cable raceway.

STANDARD is Profitable

For banks of three or more ducts, remember that ORANGEBURG STANDARD is the first choice of leading utilities, municipalities, industries, contractors and design engineers all over America. This nationwide approval is due to Orangeburg's quality and dependability and its *profitable ease of installation.*

NOCRETE is Profitable

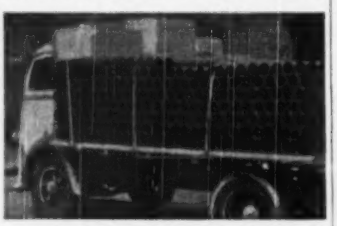
For the many single or double duct runs where it is practical to install *without* concrete encasement, use ORANGEBURG NOCRETE. NOCRETE is specifically designed with extra heavy wall for direct burial *without* concrete encasement. It is used with profit for installing the underground electrical services of . . . factories, schools, colleges, hospitals, drive-in theatres, power, telephone and other communications systems . . . also service entrances, parkway and suburban lighting, airport lighting and communication.

LOW COST FAST INSTALLATIONS

Orangeburg Conduit is easy and economical to lay. Moreover, it gives permanent protection to cables. Its impermeable wall keeps out corrosive ground waters—resists acids, alkalis, salt, grease and oil. Orangeburg Conduit is tough, resilient—no cracking or breaking when properly handled.

NOW BRANDED WITH
ORANGEBURG
TRADEMARK

FASTER, CHEAPER HAULAGE



By combining light weight with ample strength to resist breakage, Orangeburg Conduit can be hauled in capacity truck loads without damage and with fewer trips between distribution point and location. Result—transportation costs cut to minimum and job gets started faster.

EASY TOOLING ON JOB MAKES JOB MORE PROFITABLE

Orangeburg is easily tooled on the job. It can be sawed readily to any length. It lightens work for the crew—increases the contractor's savings and net profits.

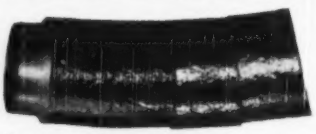
TAPERSLEEVE JOINTS SAVE TIME AND MONEY

Assembly with Tapered Sleeve Joints is surprisingly simple and fast. You merely place coupling on conduit taper and a few light taps drive it home. You get a permanently watertight joint and save money making it.

Light Weight Holds Down Handling Costs

With *Standard* 4" weighing only 2 pounds and *heavier-walled Nocrete* but 3.6 pounds per foot, Orangeburg handles fast both above ground and in the trench—all at important cost savings.

Send for Free Bend Section Folder



Illustrated folder—showing various types of Orangeburg Bend Sections and Angle Couplings—sent FREE on request. Write today to Dept. EW-5, Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.

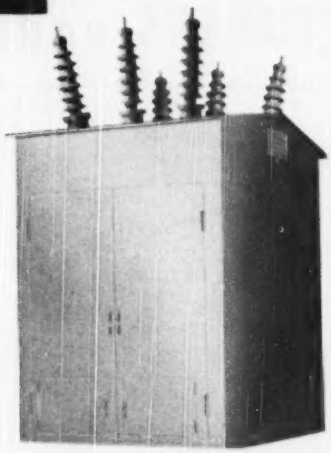
ORANGEBURG MANUFACTURING CO., INC., ORANGEBURG, NEW YORK

GENERAL ELECTRIC SUPPLY CORPORATION

DISTRIBUTORS, ORANGEBURG FIBRE CONDUIT

GraybaR ELECTRIC COMPANY

NEW!



FOR OUTDOOR SERVICE!

The Brown Boveri
HIGH SPEED — GENERAL PURPOSE
AIR BLAST BREAKER TYPE DBGH

IN WEATHERPROOF HOUSING !

Only a Brown Boveri Cubicle Type
OUTDOOR AIR BLAST BREAKER
gives you these features:

1- *COMPLETE LINE*—500,000 to 1,000,000 kVA. 600 to 1200 Amps, 14.4 to 46 kV.

2- *HIGH SPEED*—3 Cycles or less total interrupting time on 60 cycle basis.

3- *SUITABLE* for Rapid Reclosing.

4- *ACCESSIBILITY*—Steel housing completely encloses famous Brown Boveri type DB Air Blast Breaker, fitted with 4 doors for ready inspection of the unit.

5- *SAFETY*—Control unit, auxiliary switch, secondary wiring, terminals and connectors can be easily serviced through hinged service door without possibility of accidental contact with live parts.

6- *MINIMUM MAINTENANCE*—Type DB Air Blast Breaker is world famous for its low maintenance. No oil to change. Contacts can be conveniently inspected.

7- *A COMPLETE UNIT* — Factory Assembled, easy to install.

It will pay you to get complete data on the *NEW* Brown Boveri Type DBGH Air Blast Breaker

Write for Descriptive Literature!

BROWN BOVERI CORP.
19 Rector Street New York 6, N. Y.
WORLD ENGINEERING & MANUFACTURING LEADERSHIP IN MECHANICAL & ELECTRICAL POWER EQUIPMENT—FOR OVER 50 YEARS.

BROWN BOVERI

MANUFACTURERS and MARKETS

1st Quarter Earnings Set Record, GE Reports

Record first quarter profits were reported by Charles E. Wilson, president of General Electric Co, at the company's annual stockholder's meeting.

The company cleared $36,858,000 in the first three months of 1950, which was 38% more than the $26,703,000 earned in the same period last year. Earnings were 8.8¢ a dollar of sales and $1.28 a share of common stock, compared with 6.5¢ and 93¢, respectively, in the corresponding quarter of 1949.

Wilson also announced a first quarter dividend of 60¢ a share on common stock.

Average weekly production of fractional horsepower motors, small and medium motors, ballasts, and meters has increased steadily since the first of the year and in most cases is at or near a record, Wilson reported.

Television and radio receiving sets are being manufactured at the record combined rate of 30,000 units a week. Range and flat iron production will soon be at a record high, he said, and refrigerator production is 25% above the previous peak of 1941.

•

Hart Opens Chicago Lab for Electrical Testing

The first laboratory in the Midwest for product development and commercial testing of all types of electrical equipment and materials has been opened by Henry A. Hart & Associates at 23 W Hubbard St, Chicago.

Tests will be conducted on materials and devices used in generation, distribution, transformation, and consumption of electricity, including motors, generators, heating devices, insulating conducting materials, electronic components and assemblies, and electromechanical units and controls. Also available is a consulting service designed to augment the engineering staffs of industrial concerns.

Hart recently resigned as an electrical engineer in the machines and devices section at Armour Research Foundation of Illinois Institute of Technology.

NORWAY'S HIGHEST honor, Knights Cross, first class, of Royal Order of St. Olav, is presented to Walter Geist, center, president of Allis-Chalmers Manufacturing Co, by Sigurd Mosseng, right, Norwegian consul general in Chicago. Anders Fjelstad, agricultural counselor to Norwegian Embassy in Washington, is at left. Cross was given by King Haakon VII for Geist's work as chairman of 1939 Friendship fleet and reception for Crown Prince Olaf

Prices of Four Metals Up

Prices of lead, zinc, tin, and steel scrap rose in the week ended May 15. On that date lead was quoted at 12¢ a lb New York, up ¾¢ from the week before; prime Western zinc at 12¢ a lb East St. Louis, up ½¢; Straits quality tin at 77⅝¢ a lb New York, up almost a cent; and No. 1 heavy steel scrap Pittsburgh at $36 a ton, up $2. The frequently predicted boost in the copper price did not materialize.

Metals Prices

	May 15, 1950
COPPER, Conn. V., lb	$ 19½
LEAD, N. Y., lb	.12
ZINC, prime Western, E. St. Louis, lb	12
TIN, Straits qual, N. Y. lb	77⅝
ALUMINUM, base price	.17
NICKEL, base price	.40
STEEL billets, Pitts., ton	53.00
STEEL scrap, No. 1 heavy, Pitts., ton	36.00

•

Sit-Down Strike Ended

An injunction against mass picketing brought an end this month to what was described as "one of the first sit-down strikes in southern California in many years," when United Electrical Radio & Machine Workers at Zinsco Electrical Products Co, Los Angeles, abandoned the plant to take up picket posts outside. Plant officials said members of the CIO-ousted union appeared for work April 27 and 28 and May 1 but idled at their stations without working. The dispute is over seniority involving one of the 165 production workers.

MANUFACTURING BRIEFS

Westinghouse Electric Corp has purchased 13¾ acres in Belmont, Mass., for construction of a New England district lamp warehouse and sales headquarters. The $250,000, one-story, brick building will have a capacity of 6½ million light bulbs, 70% more than the lamp warehouse Westinghouse now leases at 145 Ipswich St, Boston.

Use of lead for manufacture of lead-covered cable has been declining, the American Bureau of Metal Statistics reports. Last year cable manufacturers used 130,000 tons, in tons of 2,000 lb, compared to 184,300 tons in 1948 and 208,000 tons in 1930. Low point of the last 20 years was hit in 1933 when the figure was 31,400 tons.

Special open house for General Electric Co stockholders will be held by the

THE electric power industry is now reaching a turning point in its long range progress. The postwar demands for power have been met but the rate of growth is still strong. Increased capital and operating costs have been met without substantial increases in rates. New developments in equipment have kept pace with increased system requirements. Employees have received substantial wage gains and other benefits. Financially the industry has been able to handle the huge investment requirements of the expansion period.

But this outstanding record through the postwar years does not mean that no more problems remain. Far from it!

Great as has been the growth of the industry in the past, still greater expansion remains for the future. It is therefore imperative that continuing studies be made of the sources of fuel or energy, the location of generating plants and other facilities, the interconnections that help to insure continuity of service, the costs involved in supplying service, the full development of the service area, the characteristics of utilization equipment and their effects on load curves, the application of rates that encourage full use, and of the methods to be used in financing these immense construction programs.

The electric industry must be represented adequately and forcefully in all studies of the water resources, power sites and fuel supplies of national scope. The industry must carry on its own investigations and present its conclusions in a forthright manner. It must be accorded its rightful place in the national power system of the future, where, as in the past, it will continue to provide adequate service in peace and in war, in the towns and in the country, in the home and in the factory.

It is in assisting your company in meeting these problems that PIONEER will apply the wealth of experience developed from 48 years devoted to the utility industry. We invite inquiries about our services.

Power Plant Design	Consulting Engineering
Purchasing and Expediting	Forecasts and Load Studies
Corporate Finance	Performance Analyses
Rate Consultation	Depreciation Studies
Stock Transfers	Insurance Advisers

Dividend Disbursement

Pioneer Service & Engineering Co.
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Fourteen inches back of that screen runs a high tension bus. Let a man forget to trip the supply oil switch before opening that protecting door and he'd never forget again. But with this SAFEGUARD, he CAN'T forget.

To open the door equipped with a SUPERIOR type B-1496 INTERLOCK he must have the key. And to release that key from its present location, he must open the line oil switch and lock it open. Then, and only then, can he get at the bus.

SUPERIOR INTERLOCK SYSTEM

SUPERIOR INTERLOCKS are built in dozens of types and designs to guard against the kind of human error or memory failure that spells F-A-T-A-L-I-T-Y. Write for our new catalog or ask us for specific suggestions on the form of INTERLOCK best suited to meet your own current protection problem.

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MANUFACTURERS OF SAFETY MECHANISMS OF EVERY DESCRIPTION

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company at several regional stockholder meetings, first of their kind ever planned by GE. The meetings were inspired by the turnout of almost 2,000 stockholders at the annual meeting in Schenectady, N. Y., last month. Meetings are scheduled for May 24 at Bridgeport, Conn.; West Lynn, Mass.; and Oakland, Calif., and for May 27 at Ontario, Calif.

The Chicago regional offices of Gould Storage Battery Corp have been moved to larger quarters at 100 East Ohio St.

SALES ASSIGNMENTS

COMPANY STAFFS

Trumbull Electric Manufacturing Co, Plainville, Conn., has organized its marketing department on a regional basis. Richard C. Lipps as Eastern regional manager will be responsible for field sales districts and sales engineering functions from Maine to Georgia. He has been district sales manager for New York. Allan A. Watson has been appointed Central regional manager, with responsibility for marketing activities in the Middle West and South. He has been manager of the company's Norwood, Ohio, Works and field sales manager. The California region, including California, Arizona, and part of Nevada, will be under the direction of J. Warren Barry, who has been California operations manager. Willis I. Downie, who has been manager of Northwest operations, will be in charge of the Northwest region, covering all of Washington, Oregon, and Idaho, and parts of Nevada, Colorado, and Montana.

Nordberg Manufacturing Co, Milwaukee, has named Dice Cowger St. Louis district manager of the diesel engine department. His headquarters will be at the Busch-Sulzer Brothers Diesel Engine Co division of Nordberg in St. Louis. Before joining Nordberg, Cowger was a member of the sales force of National Supply Co.

Chain Belt Co of Milwaukee has appointed Marshall E. Cusic as a district sales engineer with headquarters at the Pittsburgh district office, 1101 Grant Building, Pittsburgh 19. He has been assistant sales manager of the Rex chain and transmission sales department.

Mitchell Manufacturing Co, Chicago, has appointed George Kielty Pittsburgh district manager. He succeeds Herb Rose, who is taking over Florida for Mitchell with headquarters in Miami. Kielty has been a sales representative for Westinghouse Electric Supply Co in Pittsburgh.

REPRESENTATIVES

Unimax Switch Division, W. L. Maxson Corp., New York City, has appointed the following representatives to handle sales of Unimax precision switches: Wisconsin, Mark M. Hennessy, Mac Strauss Associates, 610 W. Michigan St, Milwaukee 3; Michigan, H. W. Walton, 1010-11 Francis Palms Building, Detroit.

Electric Products Co, Cleveland, has appointed Vincent J. Brown Co. with offices in Buffalo and Syracuse, as district representative for New York state except for metropolitan New York City.

A touch of zero in the farmer's kitchen

STRAWBERRIES in December! That's just one small pleasure for the farmer who owns a frozen food unit. More important, it preserves fresh meat and farm-grown vegetables and reduces costly marketing trips for food. Refrigeration for the farm . . . gift of electricity!

With the increasing demand for rural electrification, comes the need for efficient pole-line insulation. Hemingray Power Insulators provide the highly efficient and dependable insulation necessary for medium voltage lines.

No. 670 for 12,000-volt lines. The Technical Standards Committee of the Rural Electrification Administration has approved Hemingray Insulators No. 670, No. 680 and No. 514, under the limits of AIEE Specification No. 41-1944 for use on REA lines.

HEMINGRAY
POWER INSULATORS

American Structural Products Company
Muncie, Indiana
Subsidiary of Owens-Illinois Glass Company

Here the Hydrocrane quickly eases a pole into place. Telescoping boom is a big help when operating around overhanging wires and in close quarters.

THIS H-3 Hydrocrane, owned by John W. Daniel & Co., Danville, Va., set poles in the city of Danville for 1/10 of what it cost with a line truck equipped with an A-frame and winch. The Hydrocrane set about 40 poles per day, compared with 4 to 8 poles with the line truck—and handled the job much more safely. These poles are 60 feet long and weigh approximately 3000 pounds each.

Users also report that the Hydrocrane is extremely valuable for moving poles on and off trailers, hauling trailers, general clean-up around the company yards. Also available with clamshell bucket, grapple, trash or snow bucket. Every crane function fully hydraulic. Two sizes ¼ yard 2-ton and ⅜ yard 3-ton. Send the coupon for full information.

BUCYRUS-ERIE HYDROCRANE DIVISION
SOUTH MILWAUKEE, WISCONSIN

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LINE clearance should be done without ruthless abandon and lack of concern for unnecessary destruction. Trees which form a beautiful home setting do not have to be hacked indiscriminately. Your customer gains, and you gain good will, thereby increasing good public relations.

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NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Arizona-California-Nevada — Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Boulder City, Nev., circuit breakers, disconnecting switches, transformers, arresters, etc. for Nevada state and metropolitan switchyards, Boulder Canyon Proj., Spec. 3017. L. N. McClellan, ch. engr.

Arkansas—Southwestern Power Admin., Box 1614, Tulsa 1, Okla., 154 kv switching station and connecting transmission lines, near Van Buren. $80,000. Plans deposit $15.

Colorado—Grand Valley Rural Power Lines, Grand Junction, 126 mi. rural distr. line, 15 mi. 69 kv. transmission line and sys. imprvs., Mesa Co. **$550,000.**

Colorado—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, installing generator for Flatiron Power Plant, Colorado-Big Thompson Proj., in Flatiron Power Plant approx. 11 mi. southwest of Loveland, and 15 mi. east of Estes Park, Spec. 3013. L. N. McClellan, ch. engr.

Idaho—Bureau Reclamation, Dpt. Interior, Bldg. 1A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Mountain Home, one carrier-current telephone transmitter-receiver set with one line tuning unit for Anderson Ranch Power Plant, 600 lin ft. coaxial carrier-frequency cable for Anderson Ranch Power Plant and Mountain Home Sub-station; 2 carrier current line tuning units for Mountain Home Substation; one 115,000 volt coupling capacitor with carrier-current accessories for Mountain Home Sub-station; 1 carrier-current line trap, 600 ampere, single-frequency for Mountain Home Sub-station, Boise Proj., Spec. 3025. L. N. McClellan, ch. engr.

Illinois—U. S. Eng., 808 U. S. Courthouse & Custom House, 1114 Market St., St. Louis 1, Mo., approx. 1550 lin. ft. 34.5 kv. tower line and substation incl. installing three 150 kva single phase transformers etc. to serve East Alton Pump Station of Wood River Drainage & Levee Dist., Proj. Item L-E (1), Madison Co., Inv. GIVENG 23-065-50-94.

Ill., Humboldt—City, City Hall, Sect. 7, power plant, Sect. 8, incl. installing electric equip., and Sect. 9 installing accessory equip., water supply well, and other station facilities. Stanley Eng. Co., Hershey Bldg., Muscatine, engr.

Minn., Barnesville—City, M. Trovaten, clk., municipal electric power plant (diesel), $178,632. Plans deposit $10. General Engr. Corp., 2950 Chicago Ave., Minneapolis, engrs.

Missouri—Grundy Electric Co-operative, Trenton, 303.5 mi. rural distr. lines, sys. imprvs., Grundy Co. **$546,000.**

N. Y., Nanuet—Bureau Contracts & Accounts, Albany, power plant at Institute Male Defective Delinquents, $1,000,000. Harvey Wiley Corbett, 300 Fourth Ave., New York, archts.

North Carolina—Roanoke Electric Membership Corp., Rich Square, 500 mi. rural distr. lines, headquarters facilities and line imprvs. **$1,070,000.**

North Dakota—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point, or f.o.b. cars Dawson, galvanized-steel single-circuit towers, appurtenances for Bismarck-Jamestown 230 kilovolt transmission line, Transmission Div., Missouri River Basin Proj., Spec. 3019.

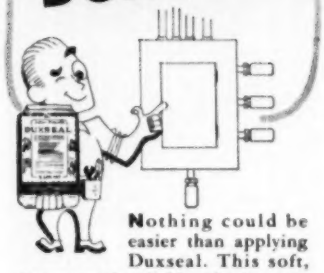
Ohio—Inter-County Rural Electric Co-operative, Hillsboro, 43 mi. rural distr. lines, 12 mi. 69 kv transmission line and sys. imprvs., Pike Co. **$630,000.**

Oklahoma—Verdigras Valley Electric Co-operative, Collinsville, 253 mi. rural distr. lines, and headquarters facilities, Tulsa Co. **$350,000.** E. R. Taylor & Assoc., 4107, E. 11 St., Tulsa, consult. engrs.

HANDY ANDY SAYS:

Pluggin's a soft job . . . with

Johns-Manville DUXSEAL



Nothing could be easier than applying Duxseal. This soft, permanently pliable plastic putty goes right into place in openings around service boxes, cable entrances, conduit ends, drill holes in foundations . . . makes a smooth, finished-looking job in a matter of seconds. Every electrician should keep a convenient, handy package of Duxseal in his tool box for on-the-spot use . . .

Remains soft—Duxseal stays soft indefinitely, but will not slump, melt or run under ordinary temperatures.

Remains tight—Clings to duct walls and cables but gives with expansion or contraction of the cable.

Remains insoluble—Unaffected by ground waters and gases.

Remains harmless—Will not injure workmen's hands or react with rubber, metals or painted surfaces.

Tight seals for other electrical uses:

J-M Tranolseal . . . for use with electrical equipment using dielectric oils.

J-M Uniseal . . . for caulking against weather and humidity. Resists temperatures up to 180 F.

If you would like to know more about Duxseal and other J-M labor-saving sealing compounds, write Johns-Manville, Box 290, New York 16, N. Y. In Canada, write 199 Bay Street, Toronto, Canada.

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SEALING COMPOUNDS

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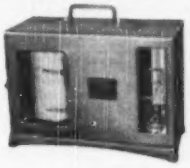
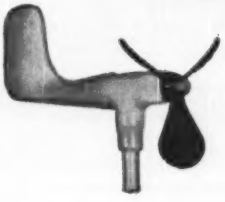
for ANY Weather Condition!

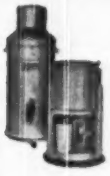
AEROVANE® DIAL INDICATORS—Separate dial indicators for wind speed and wind direction now available in 4 inch, 6 inch, 8 inch, and 12 inch diameters. Dials in any color combination and with indirect lighting can be furnished.



HYGROTHERMOGRAPH—Temperature recorder for temperature and relative humidity—Ideal for meteorological stations—particularly well adapted to the requirements of industry in general.

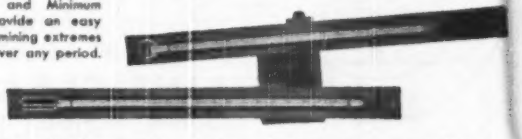


THE AEROVANE® TRANSMITTER—Combines wind speed and direction components in one unit. It consists of a three-bladed molded rotor to measure wind speed, and a streamlined vane for wind direction.



UNIVERSAL RECORDING RAIN GAGE—The universal Recording Rain and Snow Gage is designed and constructed to assure durability and long life under severe weather conditions. All forms of precipitation—rain, hail, sleet and snow—may be measured.

MAXIMUM-MINIMUM THERMOMETERS are in service at all meteorological and climatological stations to collect basic climatic data. Maximum and Minimum Thermometers provide an easy method for determining extremes of temperature over any period.



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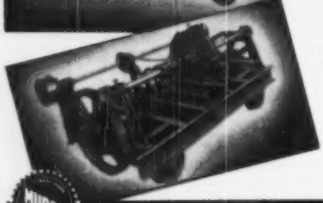
Murray Gate Hoists are designed and built to meet all requirements . . . from the smallest hand operated to large motor operated—a wide range of capacities from less than 1 ton to over 100 tons. During our nearly half a century of designing and building gate hoists we have developed various designs for the different types of gate hoist problems. We feel sure we have designs and patterns that will fit your requirements.



We also build gate hoists entirely from your plans and specifications, if desired. In planning gates or gate hoists it is suggested you communicate with us before your plans for the project as a whole are completed . . . it will save expense and much preparation time.

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Okla., Goodwell—Panhandle A & M College, Goodwell, plans by Sorey, Hill & Sorey, 809 N. W. 36 St., Oklahoma City, power house and steam distr. sys. **$100,000.**

Pa., Bloomsburg—Magee Carpet Co., Bloomsburg, power plant extens. Approx. $68,000. Louis T. Klauder & Assoc., Lincoln Liberty Bldg., Phila., engrs.

Tex., Houston—Southwestern Bell Telephone Co., 1121 Capitol St., underground telephone conduits for large cables from station at 510 Crown St. to Jacinto City, Greens Bayou, Channelview, **$1,000,000.**

Wyoming and South Dakota—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Moorcroft, Wyo., gates, gate hangers, switch assemblies, conduit liners, eyebolts for outlet works, Keyhole Dam, Cheyenne Div., Keyhole Unit, Missouri River Basin Proj. Spec. 3022. L. N. McClellan, ch. engr.

Low Bidders & Contracts Awarded

Ark., Pine Bluff—Arkansas Power & Light Co., Simmons Natl. Bldg., 6 story office, Sixth and Pine Sts., to Ebasco Services, Inc., 2 Rector St., New York, N. Y., **$1,000,000.** Selligman & Reed, Natl. Bldg., archts.

Florida—Clay Electric Cooperative Inc., Keystone Heights, 1114 mi. rural distr. lines in Columbia, Baker, Marion, Bradford, Union, Alachua, Putnam Lake and Volusia Counties, to Leo T. Barber, Moultrie, Ga., **$105,743.** Bids 4/20.

Kansas—Norton-Decatur Co-operative Electric Co., Norton, 354.48 mi. rural distr. lines, Norton Co., to Crawford Electric Co., North Platte, Neb., **$284,225.** Bids 4/19. Raymond H. Reed & Co., Columbus, Neb., engrs.

Nebraska—McCook Public Power Dist., 305 Main Ave., McCook, 328.2 mi. rural distr. lines, Red Willow, Frontier, Hitchcock, Lincoln and Hayes Counties, to Hagan Powell, 115 Sixteenth Ave. N., Nashville, Tenn., **$311,798.** Est. $334,460. Bids 4/25.

North Dakota—U. S. Eng., Fort Lincoln, P. O. Box 300, Bismarck, Apr. 28, stilling basin and powerhouse fdn. for Garrison Dam and Reservoir Proj., Riverdale, Serial No. CIVENG 32-015-50-62, from United Constr. Co., 64 W. 5 St., Winona, Minn., **$9,749,245.** Est. $10,500,406.

Oregon—Mountain State Power Co., Corvallis, 66 kv rural distr. line between Corvallis and Albany, Benton and Linn Counties, force account, **$143,000.**

South Dakota—Bon Homme Yankton Electric Assn., Tabor, 590 mi. rural distr. lines, Bon Homme and Yankton Counties, to I. O. Teigen Constr. Co., 1954 University Ave., St. Paul, Minn., **$538,480.** Bids 4/18.

Wyoming—Bureau Reclamation, Dpt. Interior, Cody, Apr. 25, constr. Alcova-Boysen 115-kilovolt transmission line, Transmission Div., Missouri River Basin Proj., in Fremont and Natrona Counties, Spec. 2955, from J & J Constr. Co., First Natl. Bldg., Oklahoma City, Okla., **$587,441.** Est. $673,517.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Nev., Henderson—Harvey Machine Co., Inc., Aluminum and Brass Div., 19200 S. Western St., Torrance, Los Angeles, Calif., aluminum reduction plant, **$5,000,000.**

Okla., Oklahoma City—Veterans Admin., Vermont Ave. between H and I Sts., 500-bed veterans hospital and treatment rooms, N. E. 13 St. and Kelley Ave. $12,000,000.

Low Bidders & Contracts Awarded

N. J., Morristown—Morristown Memorial Hospital, 66 Morirs St., 202 bed hospital, to Walter Kidde Contractors, Inc., Montclair, **$2,004,000.** Awarded 5/5. John H. & Wilson C. Ely, 744 Broad St., Newark, archts.

N. Y., Syracuse—Solvay Process Div., Allied Chemical & Dye Corp., Milton Ave., Solvay, soda and ash plant at Solvay, near here, to McGraw Const. Co., P. O. Box 272, Middletown, O. Total cost with equip. **$20,000,000.**

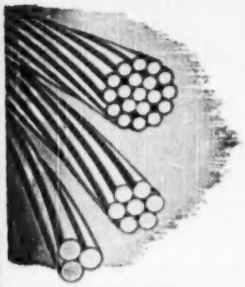
PAGE

Stainless Steel

STRAND

and Stainless-Copper

CONDUCTORS



Here's WHY they Save

Compared with other types strand of equal breaking strength, they . . .

- have 30-40% greater overload capacity within elastic limit
- resist corrosion all the way through —not merely through a thin case of soft metal
- offer highest tensile and vibration-fatigue strength (tensile strength 235,000 psi; corrosion-fatigue limit 50% of ultimate)

Here's HOW they Save

- They permit longer spans—therefore require fewer poles per mile.
- Being lighter, they are easier and faster to install in the field.
- More resistant to destructive factors, they last many times as long before replacement.

Let us tell you the whole story—

specific data, prices, recommended sizes.

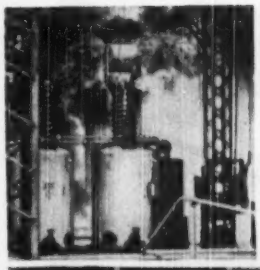
ACCO

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Pittsburgh, Philadelphia, Portland, San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

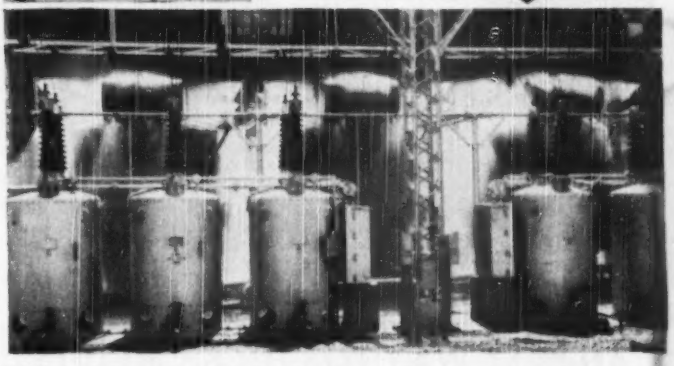
MULSIFYRE

now on guard to kill oil fires fast



This transformer fire did $50,000 damage at an electric power station.

Transformers at this electric power station are now safeguarded by a Grinnell Mulsifyre installation. Fast, automatic spray action is being demonstrated here.



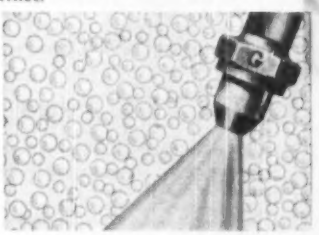
When an oil fire breaks out in transformers protected by a Mulsifyre system, a battery of spray projectors puts out the fire . . . fast. Automatic, heat-actuated release devices assure quick operation. Extinguishment occurs within a few seconds after the emulsion-forming spray strikes the surface of the burning oil.

Mulsifyre projectors are approved by Underwriters' Laboratories, Inc. for extinguishing fires in flammable oils immiscible with water. There is no conductivity along the discharge of a Mulsifyre projector when the spray strikes conductors carrying high voltages.

Mulsifyre high-velocity projectors produce drops large enough and drive them fast enough to penetrate the flames without complete vaporization in flight, but limit their velocity so the surface of the burning liquid is agitated into an emulsion instead of passing through the oil without fire-extinguishing effect. After a period of time, the emulsion breaks down, oil and water separate, and the oil can be reclaimed.

Mulsifyre systems have proven their effectiveness during sixteen years of extinguishing transformer fires. Today they protect hundreds of installations all over the world.

For information on Mulsifyre systems or other Grinnell Fire Protection Systems write Grinnell Company, Inc., Providence, R. I. Offices in principal cities.



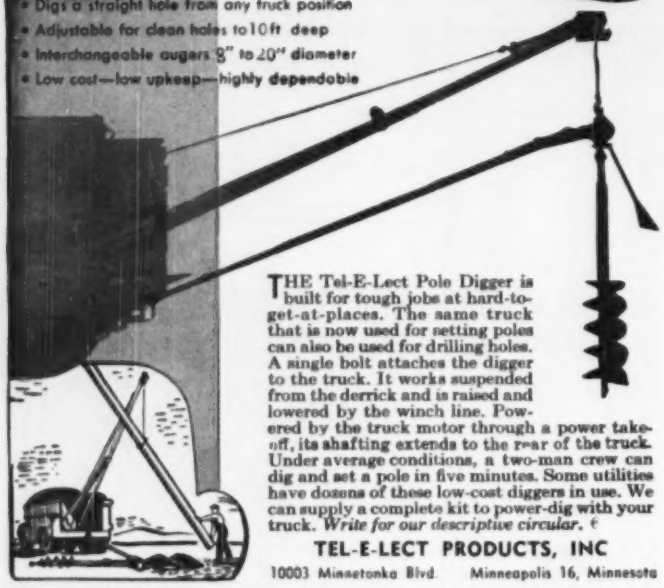
GRINNELL *Mulsifyre*

EMULSION-EXTINGUISHMENT OF OIL FIRES

DIG HOLES WITH YOUR LINE TRUCK AND CREW

TEL-E-LECT POLE HOLE DIGGER

- Digs a straight hole from any truck position
- Adjustable for clean holes to 10 ft deep
- Interchangeable augers 8" to 20" diameter
- Low cost—low upkeep—highly dependable

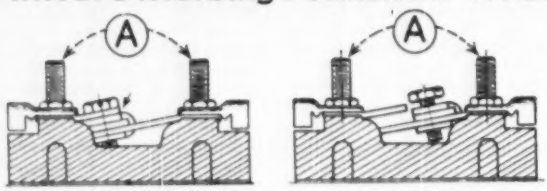


THE Tel-E-Lect Pole Digger is built for tough jobs at hard-to-get-at-places. The same truck that is now used for setting poles can also be used for drilling holes. A single bolt attaches the digger to the truck. It works suspended from the derrick and is raised and lowered by the winch line. Powered by the truck motor through a power take-off, its shafting extends to the rear of the truck. Under average conditions, a two-man crew can dig and set a pole in five minutes. Some utilities have dozens of these low-cost diggers in use. We can supply a complete kit to power-dig with your truck. *Write for our descriptive circular.*

TEL-E-LECT PRODUCTS, INC

10003 Minnetonka Blvd. Minneapolis 16, Minnesota

AN EASY WAY TO CHECK CIRCUITS
Without Disturbing Permanent Wiring



(1) Just attach instrument to Terminal posts.

(2) Slide Link out of Contact—Take reading.

(3) Slide link back and bolt in position. All testing done without touching permanent wiring.

STATES Type NT Terminal Blocks

Here is an excellent method for terminating incoming cable and panel connections for instrument, relay, intercom., and similar circuits. These blocks save space, can be mounted in any position.

Made in any number of poles desired, front or back connected, with or without coding strip, with or without cover.

Tear off and mail to
THE STATES COMPANY
3 New Park Ave., Hartford, (6)
Please send full information on Terminal Blocks

Name ..... Title .....

Firm .....

City ..... State .....

THE STATES COMPANY 3 New Park Ave Hartford 6, Conn

CATALOGS • BULLETINS

● SELLING: A package of consumer material for telling the "Go All-Electric" story consists of a silent 35 mm film, two copies of a narration to be read in presenting the film, and 100 copies of a hand-out "facts" folder. Also obtainable, free for single copy, nominal cost for quantity orders, is the manual "Fans for Year 'Round Comfort." It is intended for salesmen, teachers, and home economists. National Electrical Manufacturers Association, 55 E. 44th St, New York 17, N. Y.

● ELECTRICAL SYMBOLS: An easy-to-use chart form of "ASA Graphical Symbols for Electric Power and Control" has been published as Bulletin 5001. They have been divided into basic symbols, and symbols and adaptations. Device numbers, functions, and definitions are also listed. I-T-E Circuit Breaker Co, 19th & Hamilton St, Philadelphia 30, Pa.

● MOTORS: Ac and dc motors, M-G and diesel sets, ac generators, ac and dc magnetic starters, hoists, winches, and fans and blowers are covered in a new catalog. Duquesne Electric & Mfg Co, Broad St & Hamilton Ave, Pittsburgh 6, Pa.

● FIBERGLAS: A manual covers facts about "Fiberglas-Base Electrical Insulating Materials." Owens-Corning Fiberglas Corp, Textile Products Div, 16 E. 56th St, New York 22, N. Y.

● FLOODLIGHTS: Accessories and repair parts, installation and operating data, and the company's line of floodlights and reflectors are listed in Catalog FL-49. S & M Lamp Co, 119 W. 36th Pl, Los Angeles, Calif.

● CERAMICS: Technical information about Coors high strength ceramics for mechanical and electrical uses appears in Bulletin 1049. Landes, Zachary and Peterson, 272 S. Santa Fe Drive, Denver 9, Colo.

● MOTOR MAINTENANCE, ETC: Electrical and mechanical maintenance equipment (including commutator and motor maintenance) is described in a new catalog, No. 28. The Martindale Electric Co, 1371 Hird Ave, Cleveland 7, Ohio.

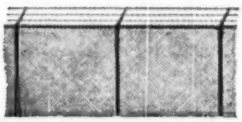
● TIME CONTROL: Time indicating and signaling systems are described in the 1950 catalog. The Cincinnati Time Recorder Co, 1736 Central Ave, Cincinnati 14, Ohio.

● REFLECTING SURFACE: A technical bulletin describes the development of a speed bake white synthetic for reflecting surfaces of lighting fixtures. Monsanto Chemical Co, St. Louis 4, Mo.

● GAS ANALYZER: Lira, an infrared analyzer for measuring atmospheric contamination and precise process control, is the subject of a 4-page illustrated brochure, No. DZ-4. Mine Safety Appliances Co, Braddock, Thomas & Meade Sts, Pittsburgh 8, Pa.

● CRANE: Information about the Karri-Go industrial crane for loads up to 5-

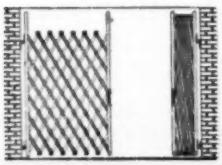
Stewart Iron Picket and Chain Link Wire Fences are being used by public utilities everywhere for the protection of equipment erected outdoors. Both types of fence offer many exclusive structural advantages you can't afford to overlook. Write for catalogue.



STYLE 3TH CHAIN LINK WIRE FENCE
Stewart famous All-Beam framework construction is the heaviest and strongest manufactured. Assures the utmost in protection.

WIRE MESH PARTITIONS—Sectional
Fit any height or width. Easily and quickly erected. When writing for prices please give all measurements involved.

STEEL FOLDING GATES



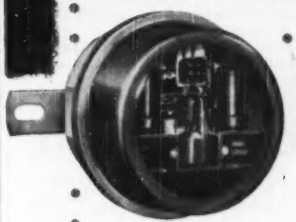
Made in single or double gate construction to fit any width opening. Prices on request. Please give width and height of opening.

THE STEWART IRON WORKS CO., INC.
1766 Stewart Block Cincinnati 1, Ohio

Stewart IRON and WIRE FENCES

Fisher-Pierce Photoelectric Controls

CUT STREET LIGHTING COSTS



Series 63300 30 Amp. contacts

Fisher-Pierce Photoelectric lighting Controls have a continuous record of low-cost service by more than 600 electric utilities in more than 17,000 installations.

Fisher-Pierce should be on *your* "Standards" list. Controls for examination and test can be shipped immediately from stock.

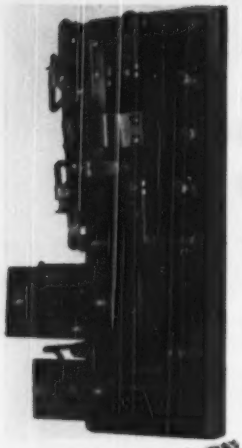
Approved by street lighting engineers and maintenance men throughout the world, Fisher-Pierce units offer a simplified Photoelectric relay for control of multiple or series street lighting systems. Fisher-Pierce controls give you long tube life (20,000 hours or more), easy servicing, (plug-in chassis construction), *no resetting after power interruptions*. In other words, exceptionally *low maintenance costs*.

Series 61300 5 Amp. Contacts

Models available for direct-connected lamp loads up to 3000 watts, for pilot-wire relay systems, and oil-switch controls for series systems.

Ask for Bulletin 63300

The FISHER-PIERCE COMPANY, INC.
82 CEYLON ST., BOSTON 21, MASSACHUSETTS



Another Important Development in the Series of ASCO Electro-Magnetic CONTROLS

POWER RELAY with BUILT-IN DELAY FEATURE

. . . factory set from ½ to 3 seconds

Again we announce an important development in the long line of ASCO Electromagnetic controls . . . this time a Fixed Delay Relay for use with Automatic Transfer Switches. With this Relay, you can set a Transfer Switch so that it will not throw on transient outage until a predetermined period—½ to 3 seconds—is passed. This avoids switch operation when power loss is only momentary.

It's a magnetically held Relay without dash pot, motors, or moving parts in the time element. Its unique built-in fixed time delay arrangement disengages on any selected value between ½ and 3 seconds. It has utility power construction and is rated at 25 amperes with single or double throw. It's the Relay now used on many ASCO Transfer Switches to guard against momentary outage due to transient conditions.

Possibly this is the very Time Delay Relay (Bulletin 1054-1885) you have been looking for. Write us about your requirements and let's see.

We also manufacture a complete line of Solenoid Operated Valves for Automatic and Remote Control of Liquids and Gases

Automatic Switch Co.

397 JERSEY AVENUE • ORANGE, NEW JERSEY

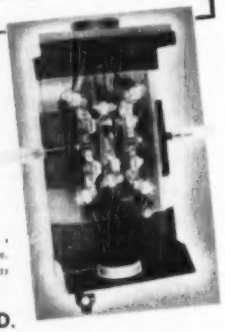
AUTOMATIC TRANSFER SWITCHES • REMOTE CONTROL SWITCHES • CONTACTORS • RELAYS

ACCURATE WIRING — THE KEY TO THE MODERN HOME — SERVICE SAVER

The Key to Adequate Service!

DUNCAN'S NEW HEAVY DUTY METER MOUNTING DEVICE is the economical method of metering modern, higher capacity services. Adequate wiring is a must for modern homes—adequate wiring requires adequate service and meter capacity.

200 AMPERES OF SERVICE CAPACITY WITH SELF-CONTAINED SOCKET TYPE METERS



Above—*Completed installation.* Right—*Meter removed, by-pass clamps in place.*

- **APPLICATION** For use with any standard 4 or 8 terminal self-contained socket type meters — singlephase, 3 wire net work, or 3 phase, 4 wire. May be used with separate demand or combination watthour and demand meters, thermal or mechanical.
- **WEATHERPROOF CASE** Galvannealed steel. Suitable for indoor or outdoor mounting. 2" or 2½" hub at top. 2" and 2½" knock outs at bottom.
- **NO SERVICE INTERRUPTIONS** By-pass clamps permit removal or testing of meter without interrupting load. See illustrations.
- **METER TESTING** Standard test jack may be used for testing meter in conventional manner.
- **LOW COST INSTALLATION** The H.D. device, list price $35.00, permits the use of self-contained meters on services to 200 ampere capacity.

Duncan Type H. D. Heavy Duty Meter Mounting Device

THE TYPE H. D. Heavy Duty Meter Mounting Device provides a compact method of connecting conductors up to #0000 copper, or 250,000 CM aluminum, directly to the terminal blades of a socket-type meter with ease and safety. The H.D. Device requires a minimum of space for metering equipment on its current range. Overall height is 18", width, 9". The H.D. Device is particularly applicable on services above 100 amperes and up to 200 ampere capacity. For complete information send for Bulletin No. 164. DUNCAN ELECTRIC MFG. CO., Lafayette, Indiana.

LAFAYETTE INDIANA

tons is given in Bulletin 72. Silent Hoist & Crane Co, 841-877 63rd St, Brooklyn 20, N. Y.

● DISCONNECT SWITCHES, ETC: The following catalogs are available from Pacific Electric Mfg Corp, 5815 Third St, San Francisco 24, Calif.: Catalogs 420 through 424 describe outdoor power-fuse disconnecting switches of, respectively, Types EG-1, EG-1G, EG-1S, EG-1SB, and EG-1W; outdoor power-fuse supports of Type EG-2 (Cat 430) and Types EG-2S and EG-2AS (Cat 431). Type EG-3 dropout fuse disconnecting switch (Cat 440), and Types AP-1 and 2 3-pole automatic service restorers (Cat 830).

● FIXTURES: Fluorescent lighting fixtures for commercial, industrial, and residential applications, with related data, are listed in Catalog 949. Keystone Electric Mfg Co, 2228-36 E. Tioga St, Philadelphia 34, Pa.

● VOLTAGE DETECTORS: A descriptive folder provides information about Cemco safety voltage detectors for testing and phasing on 1,000 to 35,000 v. Safety Electric Equipment Co, 2 Linares Ave, San Francisco 2, Calif.

● TRANSFORMERS: Information on the design of the company's power transformers is presented in 24-page booklet, B-4142. Instrument transformer construction features of the complete line, and methods of insulating current and potential transformers, are described in B-4319, 12 pages. Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.

● DRY TYPE TRANSFORMERS: Dry-type transformers, with associated electrical and mechanical data on sizes to 300 kva, single and 3-ph, are covered in Bulletin 61B6382A. Allis-Chalmers Mfg Co, 932 S. 70th St, Milwaukee, Wis.

● MOTORS: Applications, construction features, and direct-connected exciters for them, are covered in Publication GEA-5426 on Tri-Clad high-speed synchronous motors. General Electric Co, Schenectady 5, N. Y.

● SWITCHGEAR: Construction details and a summary of data pertaining to Multumite 600-v switchgear with metal-panel air circuit breakers are given in Bulletin 6003-D. I-T-E Circuit Breaker Co, Hamilton St, Philadelphia, Pa.

● FARM WELDING: Practical information on the application of electric welding on the farm is contained in a 10-page booklet, B-4157. Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.

● HEATING ELEMENTS: Information about standard bank heating elements, from 0.5 to 300 kw, is given in Bulletin 80-T. Trent, Inc, Leverington Ave & Wilde St, Philadelphia 27, Pa.

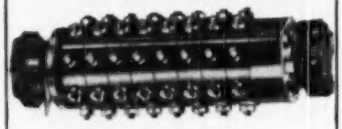
● HEADERS AND LEADS: Data and specifications on multiple headers and sealed leads are listed in Bulletins 850 and 849, respectively; Bulletin 851 covers gasket type bushings. Electrical Industries, Inc, 44 Summer Ave, Newark 4, N. J.

● SPLICING: General information on unit splicing kits for many types of cable appears in Bulletin J50. G&W Electric Specialty Co, 7780 Dante Ave, Chicago 19, Ill.

THE TESCO ROTARY TAP SWITCH

TESCO

50 Ampere Capacity



Developed for use in Circuits where requirements cannot be fully met by existing type of switches. Individual switch sections measure 2½" diameter over the housing, 3¼" over the terminal studs, length ¾".

10 OUTSTANDING FEATURES

1. HIGH CURRENT CAPACITY

Each switch section rated at 50 amperes continuous duty, with an overload capacity of 75 amperes.

2. NON-ARCING

Current interrupter, operated by the detent mechanism, momentarily disconnects the source of power when the switch is rotated to a new position so that no arcing occurs at the switch contacts, which are of the shorting type.

3. HIGH VOLTAGE CAPACITY

Switch may be rated at 600 volts.

4. FULLY ENCLOSED

Separate switch sections are made of close fitting impact resistant bakelite mouldings, giving a totalling enclosed construction which protects the working parts.

5. COMPACT DESIGN

6. POSITIVE ACTION

A notched dent operates a ball and spring mechanism at the far end of the assembly, which assures positive positioning of the rotor in any one of eight positions, 45° apart.

7. LOW FRICTION

Ball thrust bearings in each switch section reduce friction to a minimum.

8. RIGID MOUNTING

Switch is attached to the panel at 4 points around the circumference.

9. NUMEROUS CIRCUIT COMBINATIONS

As many as twelve switch sections may be assembled in one tandem unit. Each independent switch section has seven active positions and one off. Section may be arranged in any desired series or parallel combination.

10. SPECIAL HIGH CURRENT CONNECTIONS

External contactor opens the circuit before the rotary switch blades leave one set of contacts and closes the circuit again after the switch blades are resting on the next set of contacts. Twelve sections in parallel will give a capacity at 600 amperes.

Write for Bulletin #57

THE EASTERN SPECIALTY COMPANY

3617 N. 8th St. Philadelphia, Pa.

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There's no need for high tension when you put your financial printing problems in the hands of specialists. Since 1920, utilities and manufacturers have relied upon the counsel and craftsmanship of Sorg's complete financial and corporate printing service.

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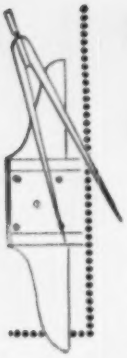

Designed to meet your needs...

TRAILERS

IN A WIDE RANGE OF SIZES AND TYPES

Combination Cable Reel and Pole Trailer — PCP & W-PCP Series: Quickly converted from cable reel to pole trailer — dual use provides low initial cost — only one trailer license needed.

P8T Series All Purpose Trailer: Combination cargo and pole trailer — new in design — versatile — many practical advantages. Front and rear bolsters, extension tongue, removable fenders and side boards, roomy cargo space.

1485-A Pole Trailer: Tubular-type tongue construction for strength with light weight. Rear bunk balances trailer and provides easy handling, when empty.

M Series Pole Trailer: 5 to 5 tons, exceptionally rugged. Heavy duty bearings permit dual tires. Extension tongue. Maximum safety, dependability, flexibility.

These trailers are representative of the wide line offered by FWD-Eagle — equipment engineered by and for utility men expressly for their needs.

FWD

EAGLE MANUFACTURING CO.

Division of the Four Wheel Drive Auto Co.

APPLETON WISCONSIN

Designed by Crysler

Write today for the complete catalog of FWD Line Construction and Maintenance Equipment — a useful reference book.

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A high grade fibre board for electrical insulation. A material of quality possessing high tensile and dielectric strength. Used by many of the leading manufacturers of electrical equipment.

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An extremely hard board of superior quality which can replace the more expensive types of insulating materials.

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PAINTS OVER RUST!

RUSTREM STOPS RUST!

No priming, scraping, brushing

Rustrem paints right over rust. For stacks, fire escapes, bridges, fences, flashings, all-metal Farm, auto, marine, machinery. Black and aluminum.

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ONLY COMPRESSOR WITH PERMANENT PEAK EFFICIENCY LIFETIME VALVES

DAVEY COMPRESSOR CO. KENT, OHIO

TECHNICAL LITERATURE

Voltage Regulator Standards—A new American Standard *Test Code for Step-Voltage and Induction-Voltage Regulators* outlines procedures for determining values of errors upon which accuracy classifications defined in the regulator standard are based. Among tests defined are ratio error of potential supply, errors in voltage regulating relay, errors in line drop compensation, compensation errors when phase-shift network is used, and others. Copies of the test code, C57.25-1949 and the revised regulator standard, C57.15-1949, are available at 50¢ from American Standards Assoc, 70 E. 45th St, New York 17, N. Y.

Contact Transients—A progress report, *Contact Transients in Simple Electrical Circuits*, covers transient phenomena in simple dc circuits. The 16-page interim report, PB 99613, is priced at 50¢ from the Office of Technical Services, U. S. Dept of Commerce, Washington 25, D. C.

Small Motors—Explanations of why there are different types of fractional hp motors, and factors to be considered in their selection, are presented in a 4-page *Small Motor Selector*. The center pages form a large chart of the various types of motors in tabular form, together with complete data concerning hp range, speed, reversibility, bearings, mountings and application. Copies of B-3075-C may be had from the Westinghouse Electric Corp, P.O. Box 2099, Pittsburgh 30, Pa.

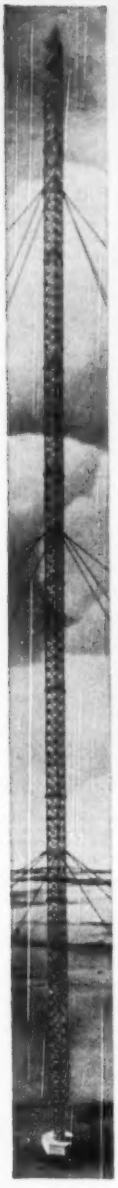
High Temperature Metals—Principal properties of molybdenum, titanium, and zirconium are stated in Vol. 5, No. 2 issue of "Tempil Topics". These metals are valuable for high temperature uses, such as encountered in jet turbines, rocket propulsion, etc. It is available from Tempil Corp, 132 W. 22nd St, New York 11, N. Y.

Storage Batteries—A revised second edition of a 40-page pocket-size handbook contains technical instructions and engineering data on the care of motive-power storage batteries. Following the theory section are four "practical" sections: Care and Operation; Maintenance and Repairs; Parts; and Technical Data. Copies can be obtained without charge from Gould Storage Battery Corp, Trenton 7, N. J.

Bearing Standard—A 12-page American Standard on *Gaging Practices for Ball and Roller Bearings* is the first of a series under development. It defines inspection methods, giving gaging loads and method of measurement. Publication B3-4-1950 is 50¢ from the American Standards Assoc, 70 E. 15th St, New York 17, N. Y.

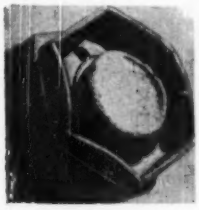
Crossarms—*Specifications for Douglas Fir Crossarms Treated or Untreated* are intended for crossarms having cross sections of not more than 4 in. on one face by not more than 6 in. on the other face. Specifications are included on grading, manufacturing requirements, preservative treatment, inspection, and dimensions. Publication TD-90 supersedes TD-61 and TD-62, and is priced at 10¢ by Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.

Meter Retirement Evaluator—A watthour-meter retirement evaluator aids in determining the economic point at which to retire watthour meters. Resembling a circular slide rule, the evaluator has scales for settings to include such factors as cost of new meters, age of old meters, and excess annual cost of old meters over new meters. It is based on an economic formula developed by G-E engineers and described in the brochure, "Time to Retire Old Watthour Meters?". Copies of the brochure (GEA-5448) and the evaluator may be obtained by sending the request on a *company letterhead* to General Electric Co, Schenectady 5, N. Y.



Truscon equips world's tallest radio tower *with* PALNUT TRADEMARK LOCK NUTS

This new 1220-foot Truscon Radio Tower, tallest ground-supported tower ever built, incorporates many advanced engineering specifications. But one important specification remains unchanged . . . the use of PALNUT Lock Nuts . . . continuing a 15-year standardization by the Truscon Steel Company, Youngstown, Ohio for all its towers.



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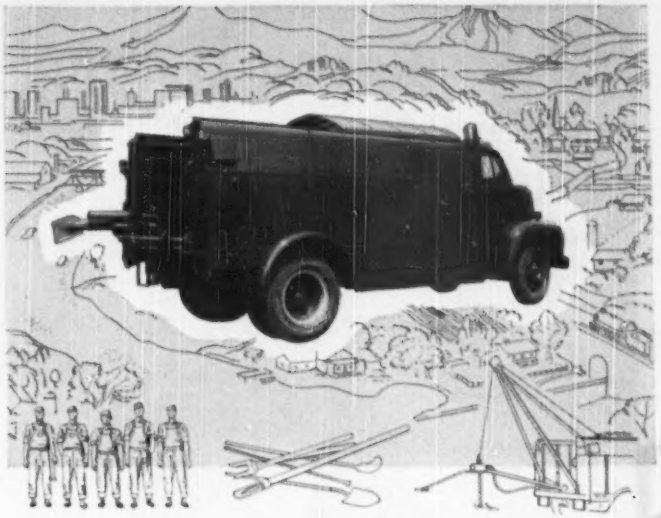

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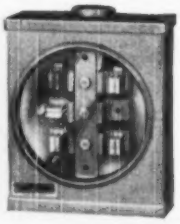

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BOOK REVIEWS

Transient Performance of Electric Power Systems. By R. Rudenberg. Published by McGraw-Hill Book Co., New York 18. 833 pages, illustrated. Price $12.

This volume is confined to phenomena in lumped networks and is by no means confined to the over-all behavior of the interconnected machine and transmission system. It starts at rudimentary levels with simple circuit switching and resonance and goes on to analyze eddy currents and commutation transients. Such manifestations as acceleration, ground-fault currents, governor interaction, line grounding and parallel induction. The second half takes up nonlinear circuit characteristics insofar as they affect such phenomena as fuse wires, arcs and interruptions, restrikes and inrush currents. Final chapters deal with shorts in alternators and the consequences of capacitive loading of generators. For the practicing engineer this is the book for reference when there is doubt about the magnitude and duration of any transient condition of electrical apparatus and its attached lines.

Hochspannungstechnik. By A. Roth. Published by Springer-Verlag, Vienna. 704 pages, illustrated. Price $16.

This is a third (1950, 1938, 1927) edition of the comprehensive work by Roth on the technology of high voltage practices. It is again a thorough compilation of the essence digested from the literature of Europe and America. The bibliography comprises over 1,000 entries to match the text coverage of insulations, oil, breakdown, waves, resonance, arcs, cables, high-voltage lines and laboratories, etc. This is the place for the American transmission and high-voltage design engineer to consult in satisfying himself that this country is overlooking no techniques tested or evolved abroad.

Lexique Technique Anglais-Francais. By Guy Maigorn. Published by Librarie-Imprimerie Gauthier-Villars, 55, quai des Grands-Augustins, Paris 6. 332 pages. Price (boards) 1500+110 fr.

Some 20,000 technical terms are translated from English to French in this new lexicon. The author has culled such authoritative journals as Engineering, Engineer, Electrical World, American Machinist for representative words and phrases of technology and commerce. A goodly percentage are electrical and others are of cognate interest. The book rounds out the recent pattern of Spanish, German and Russian dictionaries. Unfortunately this lacks a French-English inversion.

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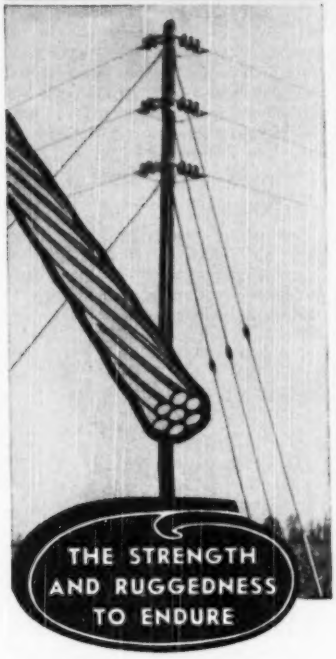

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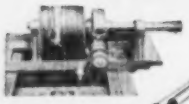

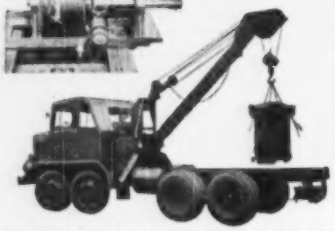

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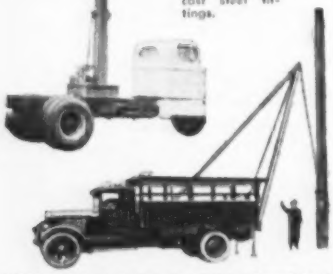

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LETTERS TO THE EDITOR

Time Is Running Out

To the Editor of ELECTRICAL WORLD:

Of course the utility people in any area where the large public power developments are located realize their own situation with regard to this form of competition. However, it is very doubtful if the utility people in general fully realize that this menace to their industry is gradually falling into a nation-wide pattern which can now be seen as shortly blanketing the whole country with a network of government owned power facilities, and co-operative systems which are financed and controlled by the REA. Also in some areas we have the "P.U.D's", which are financed by the sale of revenue bonds, and which are also part and parcel of the public power scheme. There are also the many municipally owned electric systems, which are generally either served by publicly owned transmission lines, or they are at least in close sympathy with the government's efforts to establish a nation-wide public power system.

This is no accident, but the result of carefully laid plans over a long period of years. Generally we utility people have been inclined to view these developments as just "trouble spots." In some cases there have been none of them close to us, and we have hoped they never would develop in our areas. We have had published from time to time maps showing the projects or plans of the federal agencies, but these have been rather sketchy. In some areas, such as Nebraska, Tenn., and Washington state, public power developments have had much publicity of course, but generally only one at a time. In some of the other cases the picture has not been quite so clear. And so far as this writer is aware there has not been published any complete map of the United States showing the total extent of existing and planned power facilities, coming under the above headings, and which have been revealed outside of the agencies which plan them.

The publication of such a map might come as a shock to many public utility people, and investors in public utility securities, and serve to more adequately arouse them to the seriousness of the peril which besets their investments.

Some local communities, such as the Tenn. valley, have greatly profited by these power developments. But only at the expense of the taxpayers of other parts of the nation. When the whole nation becomes blanketed with public power facilities, and all the privately owned utilities have been taken over, or forced out of business by this impossible competition which uses interest-free capital furnished by the tax payers, but which pays no taxes itself, who will benefit from public power then? Citizens of the Tenn. valley and all other parts of the country will have to dig deep in their pockets to meet the cost of the inefficient, socialized, bureaucratic operated public power industry.

Are we doing all that we can? Time is fast running out for an industry which has contributed fully as much as any other to the development and prosperity of our country and to the welfare of its people.

H. T. Wilson
Retired Utility Employee
Huntington, W. Va.

More Power Plants

To the Editor of ELECTRICAL WORLD:

Referring to your May 1st issue of the ELECTRICAL WORLD, page 3, I wish to recommend the Pacific Gas & Electric Co for second place.

I am enclosing a report prepared by Harriman Ripley & Co, Inc, covering the Niagara Mohawk Power Corp, and would suggest that you refer to page 40 where you will note this system owns 79 plants. However, it owns and controls the output, as far as generation is concerned, of 103 plants. If the Niagara Hudson Power Corp is considered, the total is 104 plants due to a Niagara Hudson subsidiary which is not a subsidiary of the Niagara Mohawk Power Corp.

J. J. Albright, Jr
Gen Supt Power Control
Niagara-Mohawk Power Corp
Syracuse 2, N Y

(Editor's Note: ELECTRICAL WORLD innocently stated that PG&E had more power plants than any other utility and asked claimants for second place to step forward. Now any claimants for third place, one step, front and center.)

What Is An Engineer?

To the Editor of ELECTRICAL WORLD:

Your editorial in the April issue of ELECTRICAL WORLD has just been brought to my attention, and I feel duty

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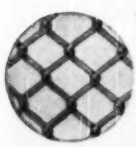

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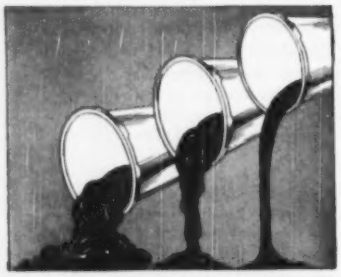

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bound to comment briefly on the purpose of such writings. You speak of an acute shortage of engineers in the 1954 to 1965 period and comment that something must be done to increase the quantity of engineering graduates from our colleges and universities. Naturally, you seek a program to propagandize the romance of engineering to prospective students in order to sell the engineering profession to them, rather than have them choose more lucrative fields of human expression.

Is this Americanism as our forefathers would have wanted it expressed? Let us, at least, be truthful with our children. Instead of writing such negative propaganda, let us formulate plans for the profession that will make the opportunity to become an engineer so desirable that the standards will become such that the best abilities of the young people in our land will strive to be known as an engineer, and whose income and standard of living will be such so as to enable each and every member of our profession to stand out and be the emulation of our young ones.

I am a professional engineer as well as a practicing engineer and I would gladly place myself at your service, if I can assist in this most important problem.

Howard C. Zachmann
Ridgway, Pa.

(Editor's Note: We think Mr. Zachmann makes a constructive suggestion with which most of his fellow engineers will agree. Our readers are invited to submit their suggestions for raising the professional status of the engineer. Why not do it now?)

Pre-printed Requisitions

To the Editor of ELECTRICAL WORLD:

The response that we have received from the article in your October 22 issue (p 114) about our pre-printed requisitions has been so remarkable that you might be interested in hearing of it . . . requests have come in from the Pacific Gas & Electric Co on the West to the New England Power Corp on the East . . . and on to the Mercyside and North Wales Electricity Board of Liverpool, England . . . It would never have occurred to me that this form would have been of interest to (so) many companies. . .

W. L. Rush
Superintendent of Distribution and Transmission
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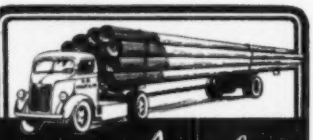

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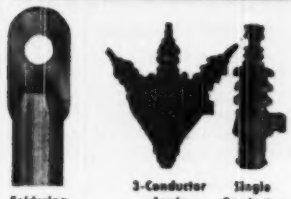

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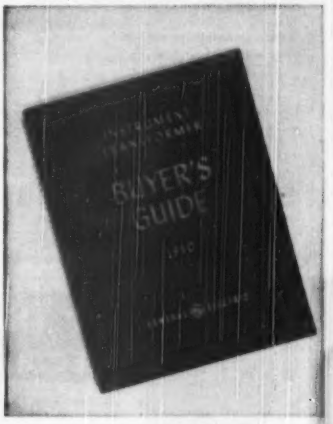

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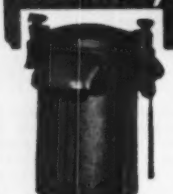

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U. S. Government

UNITED STATES DEPARTMENT OF THE INTERIOR, Bureau of Reclamation, Sealed bids (Specifications No. 2833) will be received by Bureau of Reclamation, Denver, Colorado, June 8, 1950, and then publicly opened for furnishing 4 control and distribution boards; one 1,500-kva, 4,160- to 480/277-volt, double-ended, indoor unit substation; and two 3-kilowatt, 125-volt, motor-generator-type battery chargers for Boysen Power Plant, Boysen Division, Boysen Unit, Wyoming, Missouri River Basin Project. Delivery is desired within 360 days. For particulars, address Bureau of Reclamation, Building 1-A, Denver Federal Center, Denver, Colorado.

MICHAEL W. STRAUS, Commissioner.
(100)

UNITED STATES DEPARTMENT OF THE INTERIOR, Bureau of Reclamation, Sealed bids (Specifications No. 2913) will be received by Bureau of Reclamation, Denver, Colorado, June 6, 1950, and then publicly opened for furnishing and installing one 35,000-kva, 90-percent power factor, 514-rpm, 13,800-volt, 3-phase, 60-cycle, vertical-shaft, alternating-current generator for Flatiron Power Plant, Colorado-Big Thompson Project, Colorado. Completion of installation is desired within 940 days. For particulars, address Bureau of Reclamation, Building 1-A, Denver Federal Center, Denver, Colorado.

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(101)

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1—5000 KVA G.E. 33000—2300/4000, 3 ph.
3— 500 KVA G.E. 33000-460
6— 75 KVA Moloney 33000—2300/6900
6— 50 KVA G.E. 33000—2300
4— 450 KVA A.C. 25410/44000—13280/23000
3— 500 KVA G.E. 13800-480
3— 750 KVA West. 13200—440
3— 333 KVA G.E. 13200—2400/4160 Y
3— 167 KVA G.E. 7200/12400—240/480
1—1500 KVA West. 4000—2300, 3 ph. Auto
3— 250 KVA Al. Ch. 2300—460
6— 75 KVA G.E. 480—120/240

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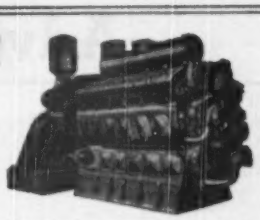

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KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
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1250	General Motors	16-278A	1400	720	312	General Motors	8-268A	450	1200
937.5	General Motors	12-567	1000	720	312	Clark	MD-6	375	327
625	Alco	6-12½x13T	750	600	167	Ingersoll Rand	8	225	514
425	Baldwin	VO-6	510	450	125	General Motors	3-268A	150	1200
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300	G.E.	Non-condensing 150/175 I.S.P. 5/10 B.P.—480 v. 3 ph. 60 cy.
400	Whse.	Non-condensing—125-150 lbs. I.S.P. 5/10 lbs. B.P.—240/480 v. 3 ph. 60 cy.

SYNCHRONOUS CONDENSERS

KVA	Make	Type	Volts	Speed
5140	Whse.		2400/4150	600
5000	G.E.	TSC	2400/4150	900
3000	Whse.		2400/4800	720

MOTOR GENERATOR SETS
3 ph. 60 cy.

KW	Make	Speed	DC Volts	AC Volts
1800	G.E.	600	125-250	2300-4150
1500	G.E.	360	275	2300-4600
1500	G.E.	600	600	2300-4150
1250	G.E.	600	275	4150
1000	Whse.	900	600	4150
1000	G.E.	720	250	2300-13200

TRANSFORMERS—60 Cycle

Kva	Make	Type	Ph	Voltages
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2000	Al. Ch.	OISC	3	13200/2300
2500	Pack.	AT	3	13800/2300
1250	G.E.	HVIDJ	1	66000x550
1000	Phila.	OISC	1	13200-2300
600	Al. Ch.	OISC	3	2300-4150x220/440
333	Phila.	OISC	1	26400x2600
167	G.E.	H9	1	2400x240-480

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2000	KW	G.E.	25/60 cy. 2300/2300 v
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2—4500 KVA G.E. 3 Ph. 27,000V, 2300V.
1—1500 KVA G.E. 3 Ph. 4150 V 2300 V Pyranol
1—1000 KVA G.E. 3 Ph. 4150 V 2400 V
1—1000 G.E. 3 Ph. 4150 2 Ph. 2400 V
1— 500 KVA Kuhlman 1 Ph. 4150 V, 2300 V
3— 400 KVA G.E. 2300 2300 V Sec.
3— 100 KVA G.E. 4150-240/480 V Pyranol
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700	*G.E.	KF-56947	1800
600	*Westg.	CS-6-34-15	1200
500	*G.E.	K-65919E	3600
800	G.E.	KTP-567	1200
400	*G.E.	IK	1800

SLIP-RING MOTORS
3 phase, 60 Cycle—220 or 440 Volt (*2200 volt or higher).

HP	Make	Type	Speed
2500	*G.E.	MT	257
2000	*G.E.	IM	360
1600	*Al. Ch.	ANY	257
1200	*G.E.	MT-38	277
1000	*Westg.	CW-524	600
900	*Westg.	CW	407
700	*Westg.	CW	720

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
1500	Westg.	6600	250
1250	Al. Ch.	4000	600
1200	G.E.	6600	250
800	Cr. Wh.	4000	575
600	Westg.	2300	125
500	G.E.	440	250
450	G.E.	2300	250
400	G.E.	2300	250

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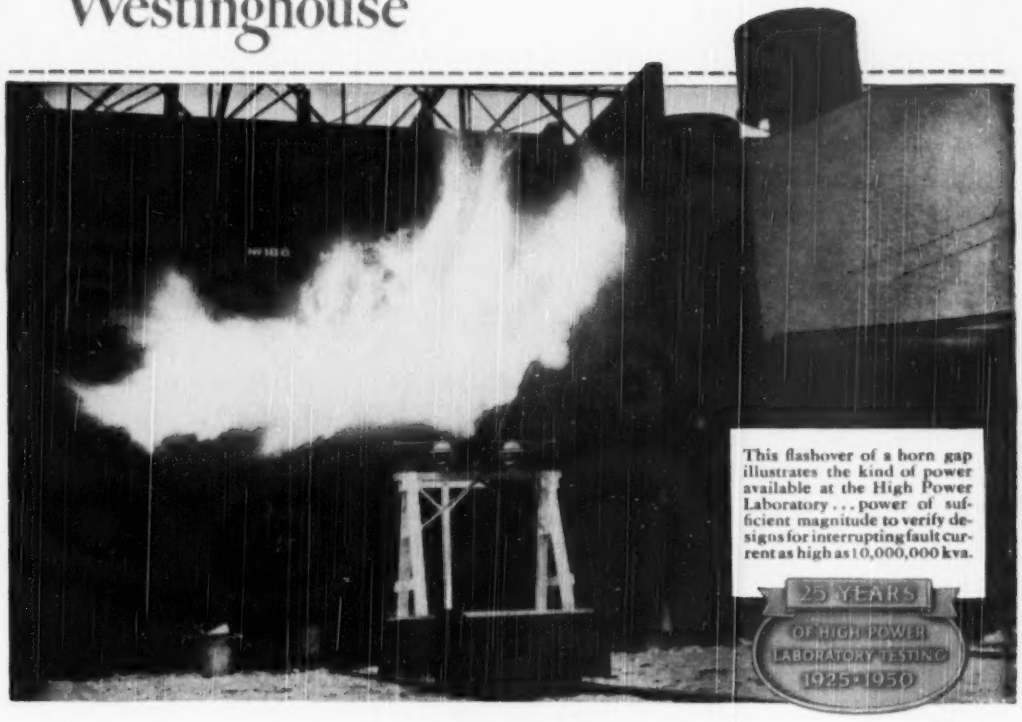

This flashover of a horn gap illustrates the kind of power available at the High Power Laboratory . . . power of sufficient magnitude to verify designs for interrupting fault current as high as 10,000,000 kva.

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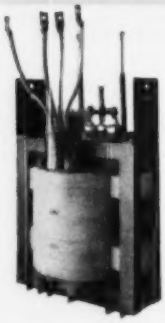
Westinghouse

HIGH-POWER LABORATORY

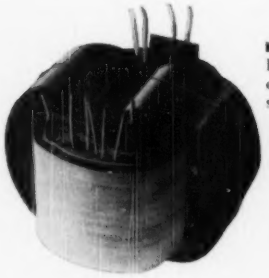
HOW SAF-T-KUHL TRANSFORMERS PAY FOR THEMSELVES

Kuhlman Saf-T-Kuhl Transformers are 100% safe because they are filled with an inert, non-inflammable, non-explosive cooling fluid. This feature pays these ways:

1. Eliminates expensive vaults.
2. Makes it possible to install units with safety anywhere in a plant so that available floor space can be used for productive uses.
3. Saves cost of secondary line copper conductors by permitting circuits to be split into several sections with a transformer the center of each.
4. Reduces power losses since Saf-T-Kuhls can be located near load centers.

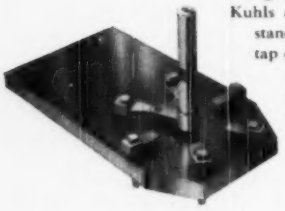


In fact, you save in so many ways that Saf-T-Kuhls often soon pay for themselves! In addition, Saf-T-Kuhls feature the same high quality workmanship and materials found in conventional Kuhlman transformers. The cooling fluid itself is a patented synthetic compound perfected after months of experimentation and testing in the field. It is equal or superior to transformer oil in dielectric strength, fluidity and thermal capacity, and does not have oil's tendency to sludge.

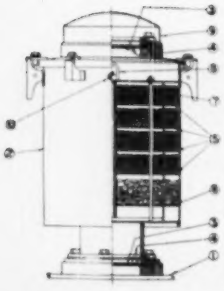


Kuhlman's famous Bent Iron Core, made of oriented steel, provides a smaller, lighter transformer in units through 25 KVA. Exciting current is reduced as much as 75%, too, over butt joint cores, by the Bent Iron Core's lapped joint construction.

Typical of the way Kuhlman builds quality into its transformers is this new tap changer with which all Saf-T-Kuhls are equipped. The outstanding feature of this new tap changer is the self-aligning spring clips on rotary blades which engage heavy stationary blades, thereby providing double surface contact under substantial pressure.



Saf-T-Kuhl distribution transformers are available in NEMA standard ratings of 3 through 3333 KVA single phase and 9 through 3750 KVA, three phase, through 15000 volts. For complete data and specifications on Saf-T-Kuhl transformers, write for Bulletin CS-501. Bulletins on Conventional, Power, Dry Type, Street Lighting and Specialty transformers in the Kuhlman line also available on request.



Gas absorbers are available on all Saf-T-Kuhl transformers at extra cost. This device is mounted on the transformer cover and contains a refillable granular material which effectively absorbs all gases before relieving abnormal pressure through the relief diaphragm.

1 Transformer Tank Cover. 2 Gas Absorber Tank. 3 Glass Diaphragm. 4 Diaphragm Gaskets. 5 Perforated Metal Trays for Soda Lime. 6 Perforated Metal Tray for Chipped Marble. 7 Anchor Rods. 8 Lifting Eye. 9 Protective Hood. 10 Test Valve.

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